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THE BELL-DRAWBAUGH TELEPHONE LITIGATION.

ON February 16th of the present year we gave an illustrated description of certain telephonic instruments said to have been constructed in the year 1866 and subsequently by Daniel Drawbaugh, a poor mechanic, of Eberly's Mills, Cumberland Co., U.S.A., who claimed to be the first and original inventor of the telephone; and since that date we have on more than one occasion drawn attention to the litigation proceeding in America, the subject of which is the alleged intention of the People's Telephone Company, holding Drawbaugh's patents, to infringe the patents of Alexander Graham Bell, the property of the American Bell Telephone Company. For the last four years this case has been occupying the attention of eminent counsel in the States, but it was not until a couple of months or so ago that it actually came before the Court for adjudication; a preliminary injunction against the People's Telephone Company, however, was granted as long ago as November 22nd, 1880. The first writ was filed in October of that year, and the complainants' *primâ facie* proof was taken on February 16th and 17th, 1881, consisting for the most part of documentary evidence, title, charters, &c. The defendants' proofs were begun on April 19th, 1881; and from that time the taking of testimony on either side, "in reply," "surrebuttal," "rejoinder," "surrejoinder," &c., proceeded until the middle of the present year, when the mass of evidence was presented to Judge Wallace, of the United States Circuit Court, New York, who now has the case under consideration, and whose decision is shortly expected.

It would be out of taste to express a decided opinion upon the case while it is *sub judice*; but we may remark that a number of volumes has been forwarded to us containing abstracts of the testimony given, the brief for the complainants on the final hearing, and the arguments of complainants' counsel. These are, of course, all *ex parte*, and it is difficult to form an unprejudiced opinion upon the evidence before us, for only abstracts of the testimony for the defendants are given, and these are dissected and discussed in such a manner as would appear to leave scarcely a shred of good proof in defendants' favour. We are not bound, however, to accept the nice distinctions, and, in some cases, apparently far-fetched explanations of the editors of the volumes; and to us, even upon the slender information they have afforded, it seems that it will by no means be an easy task to satisfy the mind of the judge that no reliance whatever is to be placed upon the accuracy with regard to dates of the hundred or so of witnesses who have testified to having seen and taken part in demonstrations of the ability of Drawbaugh to talk through his "machines" before and during the year 1875—which is the year in which Bell is said to have perfected his instrument. The facts appear to us to be incontrovertible; the only difficulty is with regard to actual dates, and respecting these there certainly is some slight degree of haziness.

Whatever may be the decision of Judge Wallace, it is very improbable that the case will rest upon it; for, as we recently stated, it is the intention of either party, in the event of the verdict being against it, to carry the case on appeal to the Supreme Court of the United States; so that in all likelihood the question of the priority of invention of the telephone will in the United States, legally speaking at any rate, be left open for some years to come.

INCANDESCENCE LAMP PATENTS.

CONSIDERING the very large sums in recent years spent in obtaining them, the question of patent rights is, to several of the existing companies, one of an almost vital character. The security relied upon may not be, probably is not, in many cases at all an equivalent to the amount which has been expended, but it is obvious that if any electric light company can obtain the absolute control of a necessary invention, or an important part thereof, then, in its case, the money expended may in the future come back to it again with a fair amount of interest for the outlay.

In our last week's issue our readers may have noticed the report of the Edison and Swan United Electric Light Company's meeting. It is evident, in looking over the figures submitted, with the directors' report, to that meeting, that unless a very decided control, or advantage, has been gained by the purchase of the Edison and Swan incandescence lamp patents, the sum, or a large portion thereof, credited to cost of patents, &c. (£178,000), might as well be written off, and the capital reduced to a similar extent. Therefore, in estimating the position of such a company, the question of patent rights is one of vast importance, second only to the question as to whether, if secured, there is a profitable business to be done. To the latter question, as applied to incandescence lamps, a confident affirmative answer can be returned.

The company which we have instanced has commenced proceedings against an enterprising young firm which manufactures largely a remarkably good incandescence lamp; indeed, the rival company, with its Swan lamp, and the firm each runs the other, in the quality of the lamps supplied, a very close race.

In the absence of any legal decision before a court of law, it appears to us that the language used by Mr. Forbes, "the most active *infringers* of the Swan and Edison patents were Messrs. Woodhouse and Rawson," is rather strong. It is not for us to decide whether or not the Edison and Swan patents have been infringed by the above-named firm, or in any way to prejudge the case, but it is of course well known that incandescence electric lighting in a vacuum was known previous to the Swan-Edison inventions, and we believe the filaments of both these systems are produced by the carbonisation of a vegetable material, whilst we are given to understand that the Woodhouse and Rawson filaments are made purely of deposited carbon without any vegetable base. All these points will of course be thoroughly brought out, should the matter ultimately become the subject of a trial, and it is most desirable that the best available evidence should be forthcoming in support of both parties, for the subject is one of quite as much importance as that of the telephone, which has for a long time past excited such a lively interest. We doubt very much if the establishment of a monopoly would be conducive to the progress

of electric lighting, should litigation take the same course as has hitherto obtained in telephonic affairs; but the winning party is not likely to consider this aspect, nor indeed is that view of the case likely to arise for a long time, for there will be many combatants to settle ere a monopoly in this field can be established.

In passing, we may mention that so far as the manufacturing of lamps is concerned, it is pretty evident that as regards consumption of electrical energy per candle-power, the Edison filament is left far behind by others; and, only about three weeks ago, Mr. Trotter showed very clearly that it would be cheaper in the end to employ lamps of high electrical economy, even if their lives were shorter, than those of a type with a lower electrical economy and a longer existence.

As regards the matter in dispute, we are informed that on the one hand, the Edison and Swan Company desires to establish as its own, a right "to the use of a carbon filament in a vacuum;" on the other, that Mr. Swan exhibited publicly at a lecture at Newcastle-on-Tyne, an incandescence lamp of such a kind, previous to the taking out of the Edison, and, consequently, also previous to the date of the Swan patent. This matter will, however, doubtless receive due attention.

In conclusion we take the opportunity to refer to another subject mentioned in the Edison-Swan report, namely, the Electric Lighting Act.

It seems to be generally agreed that it is a failure so far as pecuniary results to any company operating under its provisions are concerned.

The United Company, then, is wise to forego the idea of any central station lighting for the present. Naturally such installations must be carried out on a very large scale, and not in the limited way as exemplified in the Holborn Central Station, which is admittedly, from a commercial point of view, a thorough failure, although the company may be congratulated upon showing how well the incandescence lamp can be applied, without the aid of accumulators, to household purposes. We cannot, however, agree with Mr. Forbes when he states that in 1878 the scientific world thought the subdivision of the electric light for domestic purposes impossible. It was in that year that the late Richard Werdermann demonstrated in a very fair manner its complete feasibility.

Considering the future prospects of the Edison-Swan Company we are inclined to the belief that with its improved Hopkinson-Edison dynamos, Swan lamps, and the general completeness of its system in all details that the opinion of the directors to the effect "that there is reasonable ground for expecting a profitable business to be eventually forthcoming" is not an unwarranted one. Ship lighting by electricity is gradually developing into a flourishing trade, and in this particular branch of electrical industry the Edison-Swan Company should be well able to hold its own. The capital of the company for dividend considerations is large, but the dimensions are warranted *if* its incandescence lamp patents are secure.

THE PHILADELPHIA ELECTRICAL EXHIBITION.

THIRD NOTICE.

(*Continued from page* 390.)

The Thomson "M" dynamo, whose full capacity is 34 arc lights, of current 9·6 ampères and average electromotive force of 45 to 46 volts each, weighs complete with regulator, 3,500 lbs. The total resistance of the machine is 21 ohms, over or under, according to quality of copper and variations from gauge of wire. The average resistance of the armature measured with machine at rest, is 10·5 ohms. The resistance of the field is practically the same as that of the armature. The diameter of the armature wire is ·081 inch, and of the field wire ·128 inch. The diameter of the armature core is 21 inches, and when wound, the armature measures 23½ inches in diameter.

The machine is given 850 revolutions per minute, and developes an electromotive force at its terminals of 1,600 volts when a current of 9·6 ampères is yielded, consuming 26·2 H.P. The net efficiency is, therefore, very nearly 80 per cent, and some Thomson machines measured have given results considerably exceeding that figure.

There are various styles of the Thomson arc lamps and lamps with various regulating mechanism, as shown at the Philadelphia Exhibition. The standard lamp for general use is capable of regulating its carbons with a slow feed, and is without clockwork or liquids. These and the other Thomson lamps burn what is termed a "long" or "quiet" arc, in contra-distinction to the "short" or "hissing" arc used in many systems. It is now well understood that more light is obtainable for a given expenditure of energy in a "long arc" than in "short arc systems" where the carbons lie very closely together. The normal lamp uses 9·6 amperes, and gives an arc of 45 to 46 volts potential difference. Other current strengths may be used, as the lamp is easily adapted to them.

Figs. 23, 24 and 25 show outside views of the standard lamps—single, double and ornamental. The mechanism of the first will serve as a type of that of the others and will be described. It is to be premised that the frames of these lamps are insulated from the circuit, and each lamp is provided with a hand-shunting switch to extinguish it when so desired. The more recent ornamental designs are provided with a telescoping tube support for the globe, which greatly facilitates recarboning.

Fig. 26 is a front elevation of the parts more immediately concerned in regulating the arc length and feeding the carbon. The carbon holding rod, R, rests free to the action of gravity, and is suitably guided so as to be movable vertically only. The magnet, D, is in circuit with the carbons, but is shunted by a resistance, A, whose amount may be varied. This consists of a coiled spring of resisting wire, which can be hooked to a projecting pin on the frame, F, so as to include more or less of its length between the entering wire, X, and said frame. The wire, X, leads to the magnet coils, D, the other end of said coils being attached to the framework. The fine wire magnet, S, is in a derived circuit about the arc only, one end being attached to the framework and the other to Y, the exit wire. The magnets, D and S, are provided with paraboloidal poles, and their respective armatures borne by the lever, L, are perforated by openings with rounded edges encircling the poles. The effect is, that a uniformity of attractive force is secured for every position in its range of movement, where the same current flows in the coils of the magnets. The lever, L, L, has a horizontal extension bearing a clutch, C, for the carbon rod, R, and an air dash pot, J, at its extremity. The lower holder, H, has a clamping lever, *h*, operated from below the globe-holding plate, and is provided also with the usual adjustments for alignment of carbons. The rod, R, terminates at the top in a narrowed extension and button, B. The magnet, D, when energised at the start, attracts its armature and lifts the clutch, C, which grips the rod, R, and separates the carbons to form the arc. It continues its separating action until restrained by the increased power of the derived circuit magnet, S. The frame, F, being in circuit, carries current to R from the terminals of D and A attached thereto. The feed occurs upon a further slight increase in the power of S. The parts immediately concerned in the feed of the carbon are seen in fig. 27 in detail. The clutch, C, has a hinged portion, C^1, closed upon the rod, R, by a spring, Z; this portion, C^1, being, however, opened or released by a stop, P, near the lowest position taken by the clutch, C. The stop, P, is fixed in position. The part, L, is the regulating lever of fig. 26. As shown in fig. 28, the clutch, C, continued downward has a slotted hole, G, allowing free play of C relatively to L for a small distance about a pin carried by L. A spring, E, however, supports C elastically during the lift and feed

of the carbon rod. This "elastic connection" of the clutch and regulating armature has been made by its effect an automatic slow feed of the carbon rod, R, without the use of clockwork or dash pots in the rod,

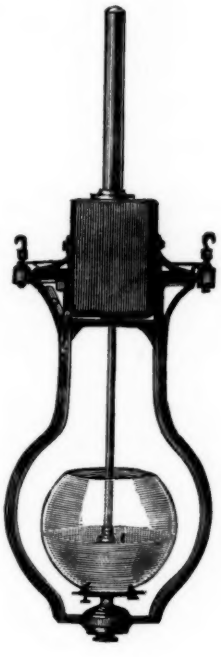


FIG. 23.

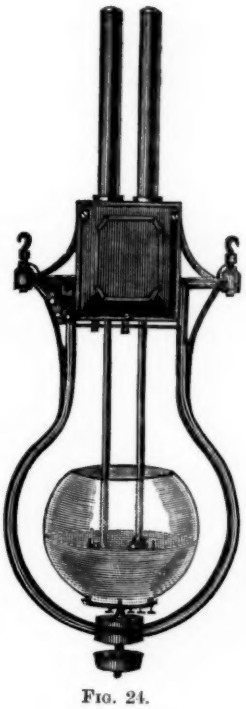


FIG. 24.

FIG. 25.

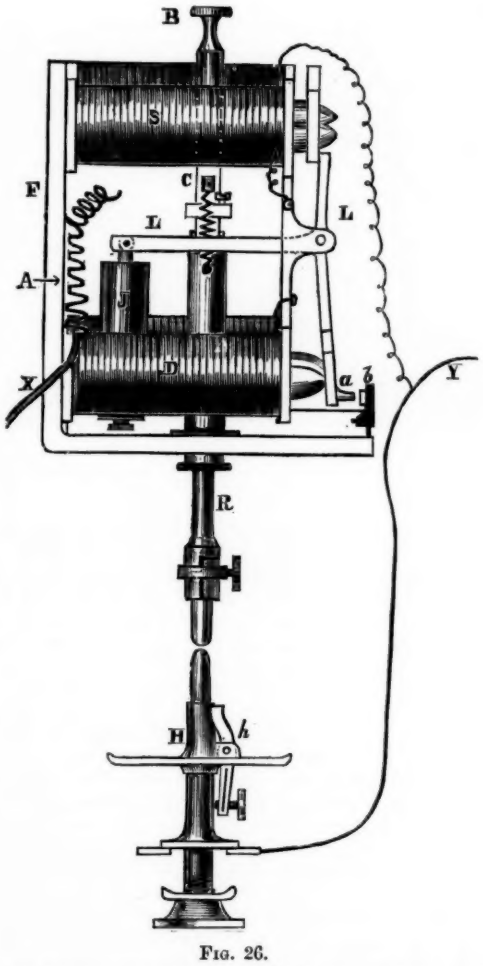


FIG. 26.

both of which are decidedly objectionable. The effect desired is obtained with the simple device above described by virtue of the fact that the moment at which a slight release of the rod, R, takes place by C^1 striking the fixed stop, P, the strain of the weight of R is partly relieved from E, and hence the clutch, C, is at once lifted by E to a position where C^1 again binds the rod, R. In practice, a slow feed of the carbon is the result,

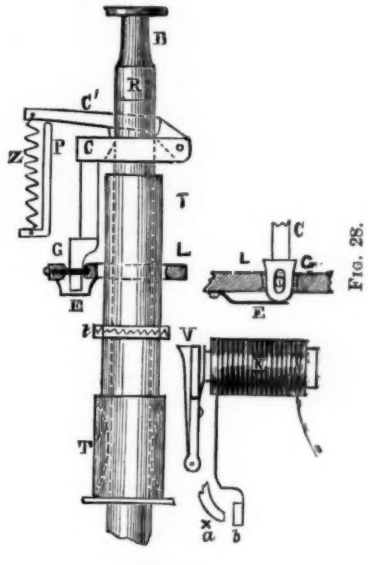


FIG. 27.

FIG. 28.

inventor in a variety of forms differing widely in construction, but all serving the same purpose, namely, to

while when the current is off the lamp, the rod, R, is left free and unrestrained by dash pots or clockwork.

These, and other features of the lamp mechanism, conduce to certainty of operation and good regulation of the arc. At the same time, should an overfeed of the carbon by accident occur, the properties of the magnet system are such that a new arc of proper length is at once drawn. This results from the uniformity of magnetic pull of the magnets. The dash-pot, J, fig. 26, is

scarcely necessary in the lamp, and gives only a slight retarding effect as used. Where it is desirable that no rupture of circuit from failure to feed shall occur, there is used one of several safety appliances. We will briefly describe that shown in fig. 27, as it is the one that has been extensively applied to the present system, and is due to the same inventor. Surrounding the rod, R, and furnishing its sole guides is a sleeve or tube, T, T^1, the lower expanded part, T^1, of which contains contact springs bearing on R. The sleeve, T, T^1, is guided in suitable openings in the framework, but is movable downwards. Normally, it is sustained by a detent armature, V, catching under a ring, *t*, as shown. The contacts, *a*, *b*, figs. 26 and 27, are closed just after the magnet, S, has opened the clutch, and a failure to feed has occurred. The contact of *a* and *b* connects a derived circuit magnet, K, around the arc, which magnet, attracting its armature, V, frees the ring, *t*, and sleeve, T, T^1, so that it may freely descend.

The function of the narrowed portion below the button, B, fig. 26, is to cause the clutch, C, to drop, and fail to lift the rod, R, when the carbons are fully consumed. There results, then, a short circuit through the carbons, and injury to the holders is prevented.

The Thomson focusing lamp is shown in side view, fig. 29. The mechanism box is back of the arc. The carbon-holding rods are L-shaped, as seen, and are guided into alignment by a vertical rod, V. The lower holder has a movement in a horizontal plane, and also an up and down adjustment, to adjust the position of the lower carbon with respect to the upper. The carbon-holding rods are geared together, so as to impart suitable relative movements to the carbons. The regulating mechanism is like that of the lamps above-described, the clutch being applied, as in fig. 30, to the upper carbon rod only. The weights of the parts are adjusted so that the carbons run together by gravity. In fig. 30, R is the upper carbon rod, W the lower.

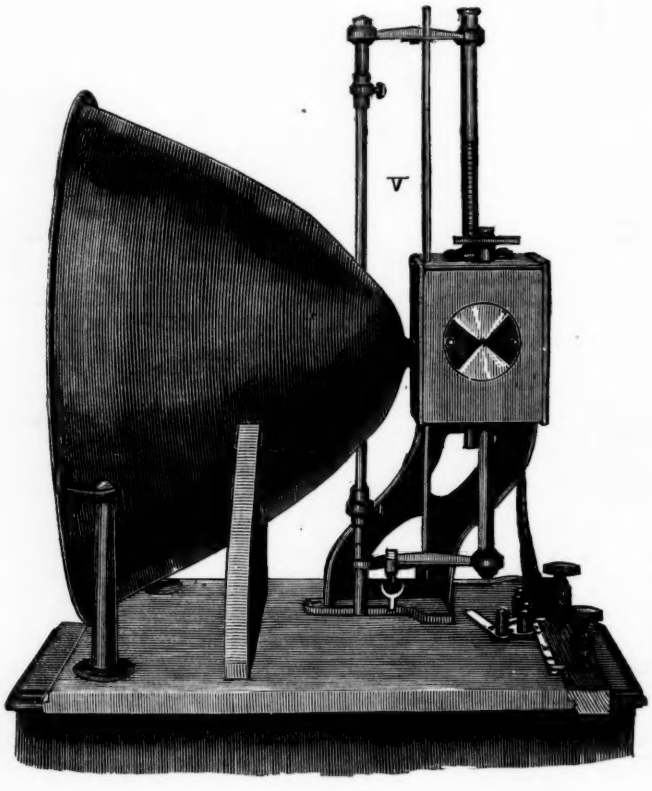


FIG. 29.

Usually in applying this device, the weight of T, T^1, is reinforced by the power of a spring bearing upon it, and the dropping of T, T^1, under the influence of such spring is made, in addition, to depress the lever, L, vigorously, and therefore force down and hold the clutch, C, in a disengaged position. To save complexity of the figures, the spring device has been omitted. It will be our purpose further on to describe some other safety appliances used in the system.

The Thomson double-carbon lamp differs from the lamp just described in the addition of a second rod and clutch mechanism, moved by the same magnets, which clutch is not released until the button, B, of the first rod has descended to its lowest point, where it strikes a lever and sets into position the releasing stop for the second clutch and rod. Up to this point, the second rod and upper carbon have remained suspended, so that no contact with the corresponding lower carbon was made. After the release of the second clutch, the arc is transferred to the second set of carbons, and burns as it did with the first set.

One of the novel features of the lamp is in the separation of the rack, R^2, from R, so as to allow the rod, R, a limited free play without moving the rack, R^2. The weight of the rack, R^2, or its downward tendency, is adjusted so that it balances the weight of the rod, W, and the appurtenances that move with such rod. Hence the rod, R, can be handled by the clutch, C, to form the arc, independently of the gear work and the friction which it involves. During feeding of the carbons, the weight of the rod, R, adds itself to that of the rack, R^2, and sets the gear work into motion. Should overfeeding of the carbons take place, the rod, R, is free to be again lifted by the clutch, C, for the formation of a renewed arc of the proper length. The operation of the lamp is therefore as effectual in maintaining a normal arc as the lamps feeding but one carbon, despite the gear work friction.

In the Thomson-Rice carbon-feed lamps for low ceilings, the endeavour has been to reduce the length of the lamp. This is accomplished by causing the clutch, C, fig. 31, to engage with the carbon itself, the jaw, C^1, C^1, being made long to compensate, in part, for

variations in the diameter of the carbons. The body of the clutch is extended upwards as a tube, T, surrounding the carbon, R, and guiding a propelling weight, Q, above the carbon. The regulating magnet lever is pivotted to the tube, T, as at L.

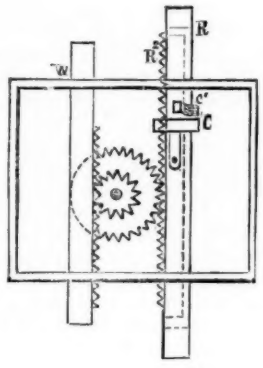


FIG. 30.

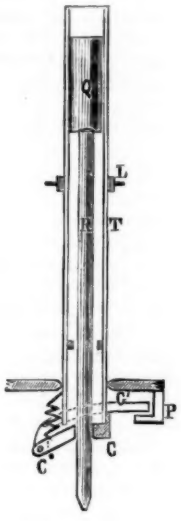


FIG. 31.

The lower carbon is as usual supported in a holder at the base of the globe. The whole tube, T, clutch, C, weight, Q, &c., partake of all the movements of regulation, and the friction is quite small, being only that of T in its guides. The piece of upper carbon left in the clutch, C, when the lower carbon is consumed, is used as a lower carbon for the succeeding upper carbon. The stop, P, is placed so as to open or release the jaw, C^1, of the clutch, C, when the latter is near its lowest position.

The Thomson film cut-out is a very simple device for automatically shunting a high resistance or point of rupture of a circuit, such as a faulty lamp. It is shown in fig. 32 as connected around the arc at A. It consists of two metal pieces, *a*, *b*, respectively connected to the two sides of the device, such as a lamp, and between which pieces exists a thin film of insulator, air being sufficient, though it is much better to use a thin film of fine oiled tissue paper, collodion, shellac, or the like, and to cause one of the pieces, as *a*, to bear elastically thereon. On the occurrence of resistance at A, that would provoke a rupture of circuit if continued, the film is punctured and the resistance shunted by contact of *a* to *b*.

The Thomson vacuum cut-out is of similar nature. Fig. 33. The pieces, *a* and *b*, are enclosed in a glass vessel, V, and are separated at slight intervals. A vacuum, such as used in Geissler tubes, is made in V and sealed. The piece, *a*, is connected to the upper carbon, for instance, as at A, and *b* is connected through a small electro-magnet, M, to the lower. The armature, N, of the magnet, M, when attracted, closes a contact at C, which shunts *a*, *b*, leaving M unshunted. The action is as follows:—An abnormal resistance at A forces the current from *a* to *b* in the vacuous chamber, V, and thus energises M, which then closes the contact, C, and gives a free path for the current around *a*, *b*, but retains M in circuit to hold the contacts, C, closed. A closing of the circuit at A results in restoration of parts to their original position, so that the actions, as described, may be repeated if need be.

Thomson's system of running arc lights in multiple series.—Electricians are in general familiar with the

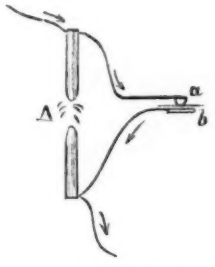


FIG. 32.

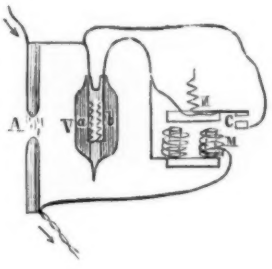


FIG. 33.

usual result of attempting to divide a current through two or more series of arc lamps. There occurs a quick series of intermittent actions, denoting transfers of the current, and the experiment has hitherto been unsuccessful. The present system provides the solution of this interesting problem, and permits arc lights of totally different powers to be run from a single circuit, some in series, some in multiple arc, or in multiple series. Divisions, redivisions, and reunion of the several divisions are easily practicable.

The current, say 20 ampères, may be split unequally, as into 12 ampères for one branch circuit, and eight for the other, or may be branched into thirds, or into three unequal branches, by simply adjusting the resistance of the lamps in each branch accordingly. Fig. 34 is a diagrammatic view of circuits arranged in accordance with this plan. G represents a generator of electricity, the circuit from which undergoes derivations with varying numbers of arc lights. There are provided coils, CC, CC, &c., consisting of bundles of iron wires, or otherwise divided iron cores, wound with a considerable length of copper wire, whose resistance, however, is low enough not to involve much loss of energy in such resistance. As seen in the figure, the position, or number of coils in each derivation is immaterial, provided that their capacity for developing extra current is great, or their self-inductive capacity is large, or if we may be permitted to use the term, their magnetic or electric inertia or reactive effect is considerable.

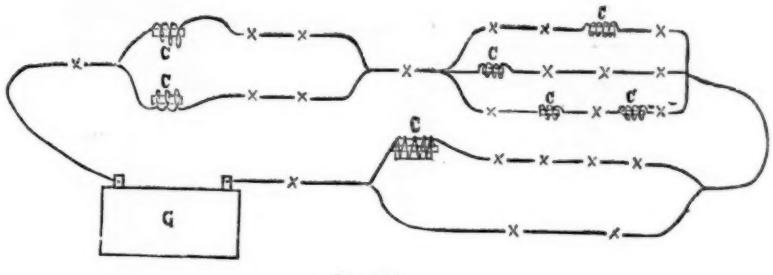


FIG. 34.

It is not necessary to place a coil in each derivation, as when the circuit is divided into two branches a single extra large coil in one branch suffices. By varying the number of lamps in each branch relatively, the current traversing the branches is adjusted, or the adjustment of the regulating mechanism of the lamps may be altered for a similar end. After arranging the system with the requisite number of lamps in each branch, it is necessary that all the lamps burn, or that equivalent lamps shall be extinguished in adjacent

branches, or that in case of extinction of one or more lamps in a certain branch, an equivalent resistance be substituted. The system is therefore best applicable to the case of city lighting, where all the lamps in the branches are lighted. Even in this case accidental extinctions might occur that would disturb the division of currents in the branches. To provide against such accidents the automatic rheostat, fig. 35, is applied.

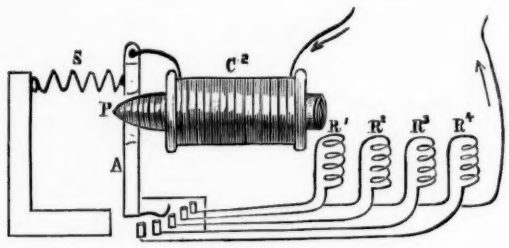


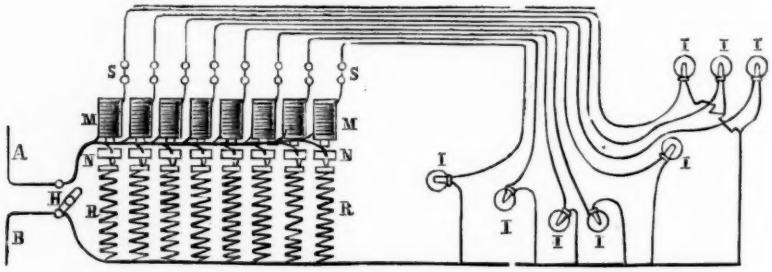
FIG. 35.

One of them is inserted in circuit with a branch to be compensated. The coil, C^2, which, if of sufficient size, may combine in itself the functions of the coil C; or reactive coil, with massive divided iron core, is put in circuit, and has a pole, P, of paraboloidal form and perforated armature, A, acting against a retractile spring, S, when attracted by the magnet, C^2. A travelling contact is arranged, upon increased attraction of the armature, A, to the magnet, so as to put successively into circuit with such magnet, resistances R^1, R^2, R^3, R^4. The action is as follows :—Should an excess of current be diverted by extinction of a lamp to the branch in which such automatic rheostat is placed ; the increased magnetic power of C^2 acting on A makes a due compensation by introducing an equivalent resistance. To do this perfectly, the available attraction of A to the magnet C^2 must be the same for a given current in all positions within its prescribed range of movement.

The Thomson-Rice incandescent lamp distributor.—This apparatus is the result of the endeavour of Elihu Thomson and his assistant, E. W. Rice, to produce a practical means of working groups of incandescent lamps, by substitution for arc lights on arc light-lines, or lines of a similar character. It is contained in a neat iron box, and is ordinarily used to replace one arc lamp of 45 to 46 volts and 9·6 ampères by eight incandescents of 45 volts and 1·2 ampères each. It is easily adaptable to other groups and other characters of circuit. It prevents any tendency to injury of the remaining lamps in a group should one or more of the filaments break. Containing no clockwork it is not liable to fail or get out of order. Lights may be extinguished at will, but no saving results except in the life of the lamp so extinguished. In fig. 36, A, B represents the main or standard current line. Entering from A, the line branches to a range of small electromagnets, and from their coils to the lamps, I, I, &c., through switches and safety plugs, as at S, S. The wire from A also branches to the range of movable armatures, N, N, which, when down, close contacts through a range of resistances, R, R, each of them being equal in resistance to an incandescent lamp, and is made of German silver wire to diminish variation by change of temperature. The current returns by a single wire to B, joined with the return wire from each lamp and each resistance, R, as shown. A shunting switch, H, permits the diversion of current from the whole mechanism when desired. In fig. 37 the connections through any single branch are exemplified alone. M is in circuit with the lamp, I, when the switch, S, is closed and attracts its armature, L, thereby open-circuiting the resistance, R, by opening the contact, C. When the switch, S, is opened the reverse action takes place.

Should a short circuit occur across the lamp, I, or wires leading thereto, the safety strip or plug, S^1, melts and opens the circuit of that particular lamp. The resistance, R, is wound upon a copper tube to avoid spark at the contacts, C. Besides the devices, figures 36 and 37, there is introduced a shunting magnet for cutting off a portion, or the whole of the main line current when accidentally excessive, and retaining it so cut off until it has fallen to the normal, thus preventing injury to the lamps. When all the lamps are being used the resistances, R, R, are all open-circuited, and the economy of working is at its maximum. In this case about 11 lamps of 45 volts and 1·2 ampères can be obtained for an expenditure of 1 H.P. at the dynamo, the loss on circuits of three to five miles being very small, when a number of arc lights, or groups of incandescents, are distributed at various points in the circuit. Allowing so high an average as three lamps per horse-power unused, and resistances inserted in circuit in their place, we shall still have about eight lamps in action per H.P. In most instances where this system is applied, all the lamps are required to burn, leaving thus an unquestionable economy of working. Owing to the strict maintenance of a standard line current by the automatic regulating devices at the dynamo, the steadiness and uniform burning of the lights are assured.

FIG. 36.



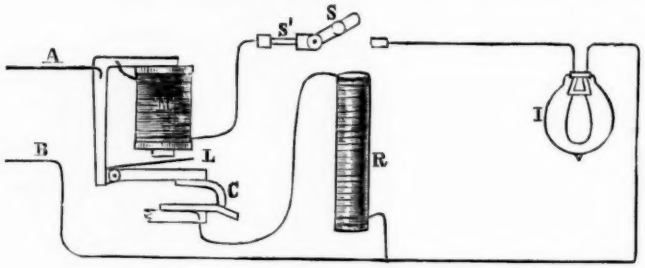


FIG. 37.

Thomson's Protector from Lightning, for Dynamos. This interesting device was invented to overcome the danger of injury to the dynamos of a lighting plant from lightning discharges taken up by the line. Its function is to permit discharge of both leading wires to earth, and to automatically rupture any short circuit of the lighting current thereby brought about. Let G, fig. 38, represent a dynamo machine working the line C.

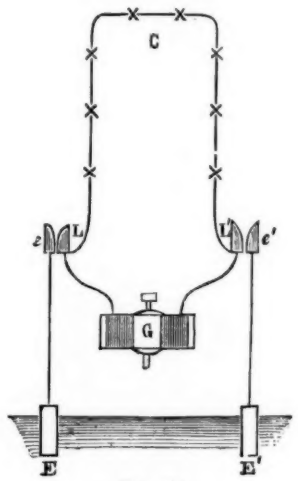


FIG. 38.

L, and L^1, are plates of metal in connection with the line, and e, e^1, similar plates in connection with earth, E, E^1, such as gas or water pipes. There is a small interval between e and L, as also between e^1 and L^1, for insulation. Now let a lightning discharge fall upon the line C; it will pass to earth at L, e and L^1, e^1, which involves the formation of a short circuit for the dynamo through the earth circuit. The disposition of the parts as shown in fig. 39 prevents the continuance of such short circuit. Here the opposed plates, L, to line, and E, to earth, are formed, so that they approach closely only at their lower portions, and spread apart above as

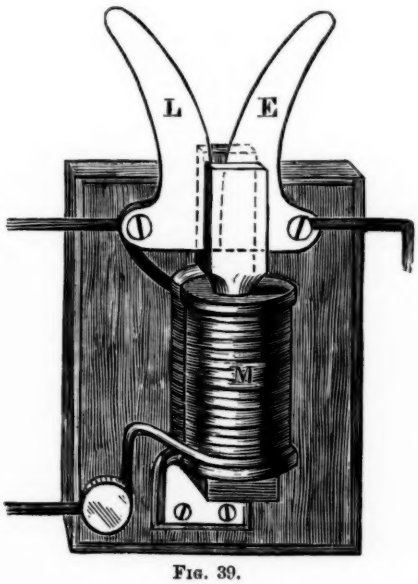


FIG. 39.

shown. The narrow space between them is situated midway between the elongated and flattened poles of an electro-magnet, M, energised by the line current in such direction as to repel upward any arc between L and E that may have formed. The arc at once rises to the wider space between L and E, and is ruptured, thus causing the restoration of the line current and continuance of the burning of the lamps if the line is still intact. The apparatus is then ready for any possible repetition of these actions. If the line has been open-circuited by the lightning discharge, the only effect is to open-circuit the dynamo.

In the International Electrical Exhibition at Philadelphia are shown, by the Thomson-Houston Company, the various inventions briefly described above. In addition there are exhibited arc lamps with different mechanisms, switch-boards for lighting stations, Thomson's self-closing switches, the Thomson-Rice ampèremeter for standardisation of regulators, line currents, &c., and especially adapted to the uses of those in charge of installations.

Among the special exhibits is a diminutive plant of dynamos and lamps, the most interesting feature of which is a very small dynamo of the Thomson type, capable of working six arc lights of approximately 60 candles each, using a current of three ampères and 120 volts. The machine has a spherical armature of less than four inches in diameter. There is also seen a combined motor and alternating current generator designed by Elihu Thomson, and feeding a local circuit of several incandescent lights in multiple arc.

The motor and generator armatures are upon a common shaft, and the main line current of high potential fed to the motor armature causes rotation, thus giving rise to the alternating currents in the second armature, which are used in working the lamps. The device is put into circuit with arc lamps, from which circuit it derives its energy.

A small Thomson dynamo is seen running as a motor and taking current from a main line also supplying arc lights in series, the motor converting part of the energy of the circuit current into mechanical energy of rotation. The motor is belted to the dynamos of the diminutive plant before referred to.

Besides other instructive models there is found a skeleton model of the Thomson dynamo, and constructed of wire coils without iron. The three coils of the armature are simple hoops of a few turns, and the coils representing the field-magnets are also simple hoop-like coils. These are mounted in the same relative positions as in the complete machine, and a wooden shaft with a three-section commutator serves as a mounting for the hoop-like armature coils. The skeleton machine thus produced, when put into circuit, revolves as a motor with great rapidity. The model is attractive as exhibiting at a glance the mode of winding and operation of the machines of this system.

There is a large factory at Lynn, Massachusetts, for the production of machines, lamps, and other appurtenances of the system in question. It is operated by the parent company, the Thomson-Houston Electric Company, and contains the laboratory and special workshop of its electrician, Elihu Thomson, and his assistant electrician, E. W. Rice, in addition to the machinery and tools for the regular production of dynamos and lamps.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MONTREAL, 1884.

ON THE SEAT OF THE ELECTROMOTIVE FORCE IN THE VOLTAIC CELL.

By Prof. OLIVER J. LODGE.

(Specially reported for the "Electrical Review.")

(Continued from page 361.)

Discussion.

Sir WM. THOMSON congratulated Professor Lodge on the interesting and almost exhaustive manner in which he had treated the subject, and invited discussion, from all which he trusted they would have, as a result, considerable acquisition of knowledge.

MR. GEO. FORBES: Those who support the theory of the electromotive force being principally at the metal contact, have been opposed simply by a suggested possible alternative, as far as I can see, and not by experimental proofs. Although many would be

quite willing to look favourably upon the view that the seat may be at the zinc liquid contact, still I do not understand that we have any definite proof in what Professor Lodge has said, that this *is* the principle seat of the electromotive force.

Mr. RICHARDSON: Professor Lodge seemed to think that nothing like a vacuum had hitherto been obtained. It would be possible to arrive at some sort of conclusion as to whether the seat of the electromotive force is between the metals in question or between the metals and liquids. It would seem proper to make experiments on this point in the best manner now possible.

Prof. LODGE explained in reply to a question from Sir Wm. Thomson that Von Zahn made a careful experiment in a glass tube which had a tube of sodium attached to it to absorb the last trace of oxygen. He succeeded in reducing the difference of potential of zinc-platinum; I think it was by half a volt. He used gravity to separate the two plates. The result was that he retained the contact theory; he did not consider his experiment upset that theory. He began agreeing with it, and left off in the same opinion. The question never has been settled by an electrical experiment, and it is rather difficult to see how it can be.

Sir WM. THOMSON: Did Von Zahn take care to drive off gases?

Prof. LODGE: Yes, he did; but I forget the precise details. The fact is I had all this matter much more completely in my head before I left England, but travelling across this Continent and back has, I fear, put it out somewhat. Answering the remark by Prof. Forbes, Prof. Lodge added: Mr. Forbes said correctly that I did not adduce any strong arguments about the seat of the contact force. I wished to open the discussion, not to close it. But my argument is really summed up in part IV. of the preliminary notes, beginning "wherever the current gains or loses energy," &c. I would say the same in mechanical language too. At the place where the energy is gained or lost there must be the force, and conversely wherever is the seat of the electromotive force in passing that point the current must gain or lose energy.

Sir WM. THOMSON: What is the meaning of gain or loss of energy by a current in proposition 25.

Prof. LODGE: A current gains no energy in crossing copper to zinc. The force acts the other way. No heat is absorbed there.

Sir W. THOMSON: Water does not gain energy in flowing down hill when caused to circulate in an endless tube not all on the same level.

Prof. LODGE: No; but it gains it in passing through a pump.

At this stage Prof. FITZGERALD suggested that Sir Wm. Thomson should give his opinion upon the whole subject, for that was what they all really wanted to know.

Sir W. THOMSON: The questions I am putting are simply for my own information, with the object of diminishing my own obscurity on the subject. It is a very difficult subject; one in which the use of words is largely mixed up with want of knowledge and with erroneous as well as correct inferences. This must be the case in all branches of knowledge; all are in some degree a matter of words. One point is the meaning of potential: as I define it, it applies only to the air near an electrified body; and that, I think, settles, not as a matter of opinion, but as matter of definition, that there is a difference of potentials between zinc and copper on the two sides of the junction between them when metallically connected. I define potential as the quantity of work required to move a unit of electricity from a point at a great distance to another point close to, but not touching, the surface, and necessarily not within the substance, of the body whose potential is considered. Suppose there is on this table a plate constituted of a copper and a zinc plate soldered together at an edge, or otherwise metallically connected. Now consider a unit of electricity brought from a position in this room at a great distance from the table, and carried first to a point infinitely near the surface of the zinc, and the required work noted. Again, bring a unit of electricity from the same distant position and carry it to a point infinitely near the surface of the copper, and note the work expended. The difference between the amounts of work required for these two operations is the difference of potential, which I assert to exist, between copper and zinc in metallic contact. My experiment, by means of the quadrant electrometer, is one positive proof of this statement; another is afforded by the condenser method originally practised by Volta. The apparatus for this latter, which I obtained from a Paris instrument-maker—Pixii, I think—in 1847 or 1848, consisted of two discs (one of copper, the other of zinc) one of which was supported on a fixed, well insulated stem, the other having a glass handle by which it can be placed on or near to the lower fixed disc, and carried away again at pleasure. From the fixed insulated stem there was suspended a pair of gold leaves, in metallic connection with the lower disc, and forming an electroscope. In the apparatus as originally constructed the discs were coated with varnish. The experiment was made thus: let down the upper disc to rest upon the lower, gently connect the zinc and copper metallically, then disconnect, and after that separate them. The gold leaves show a divergence. De la Rive suggested that this might be accounted for by cracks in the varnish and moisture in the cracks. That moisture in the cracks could produce the effect as suggested by De la Rive was disproved by scratching the varnish in contiguous parts of the discs, and bedewing the bared metals by breathing on them. The electrical result of this experiment, performed in all other respects in the same way as the other, was *nil*, or much less than when the plates were perfectly dry. That the varnish was in any way essential to the phenomenon was disproved by annulling it, and keeping the plates at definite small distances apart by means of a screw arrangement on the movable stem. I have also, in my lectures, shown this phenomenon by another method, which I may call that of multiple contacts, using still apparatus given me for the purpose by Pixii in 1847. In this case the plates of the ordinary Volta condenser were both of brass, varnished, the insulated plate being connected with the gold leaves and also with one of the two tested zinc and copper discs held in the hand, or otherwise supported—say the zinc disc. The copper disc rested upon the zinc in metallic contact with it, both unvarnished. The copper disc was lifted by a glass handle from the zinc, put in contact with the upper condenser plate, and replaced on the zinc. This operation was repeated 50 or 60 times in rapid succession; the zinc then disconnected from the lower condenser plate, and the upper disc removed away, when the gold leaves were at once seen to diverge. In a letter to Joule, of date January, 1862 (which was read before the Literary and Philosophical Society of Manchester, and which constitutes Sec. 400 of my Reprint of Papers on Electrostatics and Magnetism), I described a method of experimenting upon this phenomenon, in which the effect was accurately measured and expressed in terms of the electromotive force of a Daniell cell. The same method has been used to very good effect, but with a Bohnenberger electroscope instead of my quadrant electrometer, in researches on contact electricity by Mr. H. Pellat, described in the *Journal de Physique* for May, 1880. A detailed description of my apparatus as used in a long series of experiments, was read before this section at Swansea in 1880, and will be found, with illustrative wood cut, in *Nature*, for April 14th, 1881. The results obtained in these and in former experiments showed that the contact difference of potential between any two metals was considerably affected by heating one of the discs used, and allowing it to cool again, and that the difference of effect was due to oxidation of the surface of the metal was proved by observing that when the oxidised plate was cleaned, and the experiment repeated, the contact difference obtained was equal to that between the two originally clean metallic surfaces in air at ordinary temperatures. I also obtained a measurable contact difference of potential between two platinum discs coated respectively the one with hydrogen and the other with oxygen. If we take a zinc and a copper plate, connect them metallically and place them in a vessel of water or of slightly acidulated water, they are instantly reduced to the same potential, as might be proved by experimenting according to any of the methods which I have just described, with polished projections from the copper and zinc plates of such a cell; and that is exactly what Volta said, but without the required *potential*. The working electromotive force of the voltaic element is (as Faraday demonstrated so well—Davy, I believe, having preceded him in the idea) essentially chemical work. It is a chemical action drawing oxygen from hydrogen towards zinc, and drawing hydrogen from oxygen towards copper.

Prof. SILVANUS P. THOMPSON said that he had looked forward to this debate with some interest, because for the past four or five years he had been teaching what he had always considered a consistent account of the phenomena of the voltaic cell, and his views were substantially in accord with those of Prof. Lodge. He did not see how, with the definition of electromotive force before them, they could doubt the seat of the electromotive force in the cell. If there was at any point a seat of electromotive force, and if electricity flowed through that point, energy was evolved or absorbed. Conversely wherever energy was evolved or absorbed by the passage of electricity through a point, there, at that point, was the seat of the electromotive force. It seemed to him as obvious that the seat of electromotive force in a zinc-acid-copper cell was at the surface between the zinc and the acid, as it was obvious in the case of the combustion of coal in a furnace that the seat of the heat was at the surface where the air and carbon were chemically combining together. He protested against the limitation laid down by Sir W. Thomson in the definition of potential. Why should we be limited to measuring the potential in air? To assume that the potential at a point in the air outside a body—for example, a piece of zinc—was the same as at a point inside the body begged the whole question. Potential was a mathematical attribute of a point, and was therefore independent of the properties of any substance or material. Why should we not measure the potential at a point inside a piece of zinc, instead of inside a mass of air? It was known that when electricity passed from zinc to acid, or to water, energy was evolved, and the thermo-chemical value of the equivalent of zinc so dissolved was known. Nothing was easier than to calculate, by the very principles laid down in 1851 by Sir W. Thomson, the electromotive force between zinc and acid, or between zinc and water. Moreover, as air acted in the same way on zinc and oxidised it, the same calculation might be applied, though, owing to the very bad conductivity of the gas air, the oxidation process was a very slow one. We know in the case of an oxidising acid and of water, and we might therefore infer in the case of air that the potential of a piece of zinc was about 1·8 to 2 volts above that of the air surrounding it. A similar argument held good in the case of copper, which was about 0·8 or 1 volt above the air. Consequently when a piece of zinc and a piece of copper, each surrounded by air, were brought together, there was a rush of electricity between them in order to equalise their internal potentials. As a consequence there appears a surface charge positive on the zinc, negative on the copper. He regarded a strip of zinc and a strip of copper, soldered together, as in Volta's experiment, and immersed in air, simply as an air battery. If such a strip were immersed in acid or water it was a battery beyond all question. Let it be immersed in distilled water, which was almost a non-conductor, it was still a battery having the same electromotive force as before, but yielding practically no current. And the transition to the

air-medium from the water-medium was perfectly simple. He thought that we should have to recast our definition of electromotive force in a manner similar to that in which Tait had recast the definition of mechanical force. Electromotive force at any point in a circuit ought to be defined as the rate of spending energy per unit of electricity flowing through that point.

Prof. J. WILLARD GIBBS remarked that in other departments of physics the location of the force producing certain results had been a matter of dispute. In the case of the liquid sustained in a capillary tube, the seat of the sustaining force has been placed by some physicists at the top of the column sustained, by others at the bottom of the tube. In the case of the circulation of water in pipes for the warming of houses, the moving force may be ascribed to gravity acting upon vertical columns of water of different temperature, and therefore different density. But the seat of the force may also be placed in the furnace where the water is expanded by heat. In both of these cases the apparently opposite opinions may both be regarded as correct. Even if our knowledge of the processes in the voltaic cell were as complete as it is with regard to the more simple phenomena alluded to, we may suppose that it would still be possible to regard the electromotive force as located in more than one way.

Sir WM. THOMSON, replying to Prof. Fleming, said in reference to the dictum that "two metals in water, or diluted acid, are at the same potential," that the statement must not be taken too absolutely. There were many circumstances which would modify it; anything, for instance, which introduced polarisation to a large extent. It is really an experimental result, true, at all events, when the liquid does not differ much from pure water, and when the plates are left connected by the liquid alone, for long enough time after a metallic connection between them to allow "polarisations" to subside.

Prof. SCHUSTER expressed his belief that a vacuum of less than half a millimetre had not been obtained. His experience had been that attempts to improve vacuo by sodium, and other things generally, rather spoilt it.

Dr. MACFARLANE: Recently I made a series of experiments which have a bearing on the question discussed. I measured the amount of electricity developed on discs of different metals by friction. The disc was given a single whisk by means of a camel's hair brush, and the amount of electricity produced was indicated by an electrometer. The result was, that the metals came out in the following series:—Gold, platinum, tin, silver, copper, lead, brass, nickel, iron, aluminium, zinc, magnesium, antimony, bismuth. This series agrees well with the mode in which the chemists arrange the metals according to their affinity for oxygen; and this fact shows that the gas in which the metal is immersed has an important influence. The results of these experiments support several of the positions maintained by Prof. Lodge.

Dr. DONALD MCALISTER; May I ask Sir W. Thomson—Suppose we had a perfect vacuum, and a piece of copper and zinc were both brought up from a distance, and made to touch. Sir William says there is a difference of potential between them; that means that energy is generated. I want to know where the energy came from?

Sir WM. THOMSON: There is work done by the chemical action at a distance. Old Volta was quite right. The work done by the zinc attracting the copper is enough to produce the small amount of electrification which exists. If you put two plates, one of zinc the other of copper, together at a corner, a small amount of work is done. If you let their faces come nearer together, their corners being still kept in contact, they attract one another with a definite calculable force. They are doing work which is in point of fact a chemical action at a distance.

Prof. FITZGERALD pointed out that, as had been hinted by Sir Wm. Thomson and Prof. Gibbs, Prof. Lodge's confidence in Clerk-Maxwell's statement as to the value of the Peltier effect as a measure of the contact electromotive force was hardly justified, inasmuch as the Peltier effect is connected with the variation of electromotive force with temperature and not with the total electromotive force. He doubted whether any existing experiments or arguments could settle the question. He asked Sir William Thomson whether he thought that the whole electromotive force of contact between zinc and copper could be measured by the heat of combination of zinc and copper, as if so this seemed insufficient to explain more than a small part of what is usually called the electromotive force of contact of zinc and copper in air. He further asked for an expression of opinion on what Prof. Gibbs had called attention to, namely, whether it is the total, or only the available energy that is the proper measure of the electromotive force.

Prof. MACGREGOR: With regard to Sections 12 and 13 of the "preliminary notes," it seems to me a question about words. It would be well if we could get to facts not now sufficiently known among us. I think these are pointed to in the sections here named. I was led to expect that we should have from Prof. Lodge a reference to the foot note on page 6, which says:—"Certain portions of these statements which may appear wildly hypothetical," &c. On reading Section 13 I did think it was wild, hence I wanted the numbers by which it was justified. I hope Prof. Lodge will enlighten us on this matter.

Prof. LODGE: The matter referred to is very important, but I fear there is no time for me to go into it now. I only omitted what has just been referred to as Section 13 for want of time, and as the matter involves a considerable number of figures, I think it had better be put into print. When Sir William Thomson got up, he began by saying what I hoped to be able to agree with, but then he went on to make statements which I am bound to think perfectly false, and yet which at the same time are very difficult to bring home to him in that light. If I may venture to say so with all deference, I shall hope to bring him round presently. Of course he is at perfect liberty to use any definition of potential he likes, but may I ask him to consider whether it will not simplify matters very much to alter his definition? Is it not true that all parts of a conductor must be at one potential, except in so far as there is internal electromotive force? Here we have zinc and copper in contact. There is a rush of electricity from one to the other. Now is it not simplest to say that the metal part is at one potential and that the air has a varying potential. The varying potential occurs in the dielectric, the uniform potential in the conductor. With regard to what Prof. Fitzgerald says, if you want to measure the true contact force at any point you can do it only by sending a current and measuring how much energy is absorbed or generated there. Sir William Thomson speaks of the attraction of zinc for copper. It is true there is a force of attraction between zinc and copper: but why do they attract one another? I say they would not attract one another in a vacuum. The attraction is not to be measured by the heat of their combination. If you take zinc and copper and make brass, the heat of combination will not account for anything like the electrical attraction which really exists; what will account for the zinc attracting the copper is the difference between the heats of combustion of zinc and oxygen and of copper and oxygen. Imagine a piece of zinc in air or water, or anything oxydising. You have around it oxygen molecules trying to combine with it, and not able to do so, because electricity behaves like an incompressible fluid. They are straining at it equally all round. Take a piece of copper, and you have the oxygen molecules all round straining similarly, but with less force. What do we do by putting the two in contact? We sweep away the oxygen from one side of the zinc by bringing copper into contact with it instead. The oxygen is pulling at the zinc and also at the copper, but not so hard; the consequence is these move to the zinc, and from the copper. Transference of negative electricity takes place from the zinc to the copper. The zinc has now a greater tendency to become oxydised, although it is not oxydised. Copper is to a certain extent protected. The transfer of electricity is produced, not by any electromotive force at the junction of zinc or copper, but by the potential chemical action, the straining of the oxygen to the zinc being stronger than that of the oxygen to the copper. As regards the action of different gases, this theory requires the difference of potential to be in general different. Now if it be true that the copper-zinc attraction is not determined by the copper-zinc combustion, but by the zinc-oxygen minus the copper-oxygen combustion, I am not quite sure whether it will have any effect on Sir William Thomson's theory of the size of atoms; possibly it will not, but I think it will affect his data. He says, take a number of thin plates, and build them up so as to approach molecular combination until certain work is done. That is right. But what ought that work to be equal to? He says, to the energy of the combination of the copper with zinc. That is where we differ. I say it is probably represented by the energies of combustion. I fear there are no data for copper-zinc combinations at present; if there were it would settle this point. Measure the heat of formation of brass, and it will be found, I believe, to be enormously less than is necessary to account for the observed volta effect. That is precisely the point on which we differ, and it is more important than a question of words or any mere definition of potential.

Sir W. THOMSON said Prof. Lodge had argued admirably as to conceivable influence of oxygen in connection with the two metals. But the question whether or not that has to do with the ultimate state of things I refer to, is this: will the compound made by excessively thin sheets of zinc and copper, include bodily a large enough proportion of oxygen? If it includes a considerable portion of oxygen Prof. Lodge might possibly be quite right; but if, on the other hand, the phenomenon would be really the same if the experiment were made with nitrogen gas, as I believe it would, we are forced to the conclusion that the main attraction is due to the copper and the zinc. It is important to settle that the action really takes place in vacuum, or in nitrogen, or in oxygen, or in other comparatively inert gases, as in ordinary air.

Prof. LODGE: It seems impossible to get a vacuum. The plan is to have plates cleaned in an atmosphere of nitrogen or hydrogen and pare them down in that gas. Never let them go out of it; and then try the effect in pure inert gas.

Prof. SILVANUS THOMPSON suggested an experiment which he said "would settle the whole matter." Let me refer to Sir W. Thomson's experiment of 1851, wherein there were two discs of zinc and copper placed underneath a charged leaf, that leaf turning the one side or the other toward the zinc when they were brought into metallic contact, but not so turning when these plates were connected by an oxydising liquid or gas. The experiment I want tried is this: take plates, not of zinc and copper, but of iron and copper, with a medium not of oxygen but of sulphuretted hydrogen. I take that because the combustion equivalent of copper and sulphur is higher than of iron and sulphur. Ascertain which way the needle turns in the sulphurising medium. If Prof. Lodge is right, and I agree with him in the main, the needle will not turn to the more oxydisable one, but to the more sulphurisable one.

Prof. LODGE: That experiment has been pretty well carried out by Brown, but it has not been held to settle it. There are always loopholes. The plates get tarnished.

Sir WM. THOMSON expressed the conviction that the discussion (which had lasted some two hours and ten minutes) had been

eminently successful, particularly in the admirable paper drawn from Prof. Lodge by the occasion. The disputants had appreciated the pleasing as well as instructive remarks of Prof. Gibbs; he had, in fact, made them all happy by telling them they were all right.

A vote of thanks to Prof. Lodge was then put and heartily carried.

Sir WM. THOMSON announced the proposal to strike a medal in connection with the McGill University to permanently commemorate the meetings of the Association.

We understand that the opening paper of this discussion is to be printed *in extenso* in the annual report of the association, together with all the additional matter which was omitted at the meeting for want of time.

THE USE OF SECONDARY BATTERIES IN TELEGRAPHY.

By W. H. PREECE, F.R.S.

ABOUT the middle of last year a series of experiments with secondary batteries was commenced on some of the telegraphic circuits, terminating at the General Post Office, London, and their satisfactory behaviour during 12 months' trial leads me to bring this subject before this section.

Dynamo-electric machines are regularly employed for signalling purposes in the United States. I think, therefore, before detailing the results of the experiments with secondary batteries in England it would be advisable to mention the experiments made with such machines there also. So long ago as the year 1865 the late Mr. Cromwell Varley tried a Wilde's machine on several circuits at the Electric and International Telegraph Company's station in Telegraph Street, London. About 1870 the Lancashire and Yorkshire Railway Company used one at Manchester. In 1872 Mr. Culley experimented with a Gramme magneto machine on several Post Office lines of moderate length. It was found, however, that trouble arose from the great variations in the strength of the current due to variations in speed, from the rapid corrosion of the contact points in the instruments, and from the intermittent disconnections at the machine. These disconnections were apt to cause serious errors in a message by changing the character under transmission, or at least to produce loss of time by creating repetition.

The improvements made in dynamo machines since 1872 would doubtless overcome these difficulties, but no advantage would be gained by using them for the English system of telegraphy, for it would be difficult to obtain suitable changes of potential, or to adjust the dynamic effects of the very numerous classes of lines radiating from the machine. England, unlike America, is subject to frequent meteorological variations, and the majority of its telegraphic circuits are always liable to a transformation from simplex to complex systems of signalling, or *vice versa*; moreover, the double current open circuit system being in use throughout Great Britain, uniformity of current is absolutely essential, especially where automatic working is in use. Rapid reversals of equal strength cannot be insured from a dynamo machine.

In 1879 Mr. Louis Schwendler, the late electrician of the Indian Government, communicated to the *Philosophical Magazine* an interesting account of some experiments he had made with a dynamo-electric machine for signalling purposes, while the dynamo was simultaneously working a powerful electric light. The telegraphic circuits were applied as a leak to the main lamp circuit, and it was apparently found that the small signalling currents tapped off did not produce any perceptible variation of the electric light. He therefore suggested that if the main current from the dynamo could be employed for electric lighting, or other useful work, which would repay the expense of the erection and working of the dynamo-electric machine, the signalling currents would cost nothing. This, of course, assumed that the electric light machine was always running.

In telegraphy exceedingly weak currents produce the desired signals. These currents are expressed in milliamperes (the thousandths of an ampere), and can conveniently be obtained from a battery at pleasure. Furthermore, the number of independent units into which a battery of even a moderate size can be subdivided is a very weighty advantage of which a dynamo-electric machine is wholly void. Now, if dynamo-electric machines were substituted for batteries at convenient English offices, there would still be a very large percentage of batteries required. The Postal Telegraph depot had in use last year 129,789 cells of the bichromate, Daniell, and Leclanché type. And if at the seven principal centres where steam engines are working for the pneumatic system all the cells (amounting, approximately, to 38,773) were replaced by dynamos, we should still have 70 per cent. more batteries than those replaced, for which dynamo-electric machines could not be substituted.

I will consider the London central station alone, as it contains about six times more cells than either of the other six offices. In March of the current year there was a total of 687 circuits, radiating from the chief offices through England, Ireland, Scotland, and Wales; and the various classes of circuits require different strength of current ranging from 14 to 80 milliamperes. The full current for all the circuits, viz., 20 amperes, has been approximately determined by adding together the currents necessary for each kind of instrument. The total battery-power for these circuits was about 20,000 cells, which implies an approximate electromotive force of 28,000 volts, or an average of 40·75 volts per circuit. From this data we find that the total electric energy for all the circuits would be $\left(\frac{28{,}000}{687} \times 20\right) = 815$ watts, or 1·09 horse-power, which would equal 0·0016 of a horse-power nearly for each circuit.

The total number of circuits include 290 distinct sets of special apparatus like those aforementioned, and employ 7,956 cells, or an average electromotive force of 11,112 volts. The output of current for these circuits is estimated at 6 amperes, therefore the energy expended equals $\left(\frac{11{,}112}{290} \times 6\right) = 230$ watts, which are equal to 0·3081 horse-power. After deducting this from the total horse-power, 1·09, we have left 0·782 as that which might be developed by aid of a dynamo-electric machine in place of batteries. But this small amount of energy represents 397 circuits, which must be divided into groups of, say 40 circuits, to facilitate expeditious removal of faults, as well as to reduce the number of lines subject to stoppage by a fault occurring on either branch within reasonable limits. We should then have to provide eleven dynamo-electric machines, ten for the actual work and one for reserve, for we must endeavour to avoid a long cessation of telegraphic transmission. Suppose the 40 circuits grouped on one dynamo demanded an electromotive force of 40 volts, and a flow of one ampère current from the generator, when all were working simultaneously the maximum horse-power would be 0·053 as compared with the minimum, 0·0013, horse-power required for a single circuit, showing a variation between ·0013 and ·053 of a horse-power. We clearly have an exceedingly small expenditure of electrical energy for a dynamo to develop in compensation for the constant consumption of coal, wear and tear of engine, &c., and incessant attention required. Calculation, however, brings out the annual cost of maintenance of dynamos considerably below the annual cost of maintenance for voltaic cells. We find the mean cost per cell per annum to be 2s., which, for 12,044 cells (the number we assumed to be replaced in the London Post Office by dynamo-electric machines) amounts to £1,204 8s. a year. Now, suppose the dynamos had a commercial efficiency of 80 per cent., the mechanical energy necessary to produce 0·782 of a horse-power, as electrical energy would be 0·977, or say one horse-power, and as horse-power requires about 4½ lbs. of coal for its production, the cost of coal at 20s. a ton for twelve months' running of dynamos averaging 18 hours a day, would be £14 16s., the annual cost may be specified thus:—

Wages of four men at 25s. a week ...	£260	0	0
Four per cent. interest on the plant valued at £1,300	52	0	0
Depreciation at 10 per cent.	130	0	0
Coal at 20s. a ton	14	16	0
Waste and oil	10	0	0
	£466	16	0

which shows a balance of £737 12s. in favour of dynamo-electric machines. Nevertheless there would be a decided disadvantage in using them, not only for the reasons already assigned, but also in the event of fire, when we could not so quickly or so aptly restore communication as with batteries. In the latter, batteries could be easily applied to the respective circuits at the nearest point of safety, whereas engines or dynamos would introduce many difficulties, and cause much loss of time. Finally, it should be remembered that the cost of batteries is so small an item in the general maintenance of the entire system of telegraphy that its consideration may be ignored. It is a question of efficiency and not of economy that will determine their use.

The first experiment with secondary batteries was that of eight so-called half horse-power Faure-Sellon-Volckmar cells, working a universal circuit system consisting of 31 distinct and separate circuits. These worked continuously for seven weeks without the slightest hitch or attention. Then came eight of Mr. Tribe's secondary cells, which were put on a similar universal set of 30 circuits, and worked it successfully for 52 days 2 hours. When exhausted the cells were joined to a dynamo, and a current of three ampères passed through them for 48 consecutive hours, no attendance beyond a casual glance being required. They were again started on the same circuit and lasted 58 days; a third similar charge was given them, and the circuit worked efficiently for another seven weeks. Their behaviour was so good that we had no occasion even to look at them until a day or two before exhaustion. With two of the same kind of cells a local sounder circuit, requiring five of our largest Daniell's was successfully worked without any attention for eight weeks. A further and very valuable experiment was also made with twelve Faure-Sellon-Volckmar cells on a universal set consisting of fifteen circuits, which terminated after fifteen weeks, or, excluding Sundays, ninety-two days' work. These were replaced by fifteen double fluid bichromate cells of quart size, and instructions given to carefully note the quantity of material used and time of attention bestowed upon them during the same period of action, viz., fifteen weeks. The particulars of this comparative test were as follow:

The secondary battery worked ninety-two days, averaging twelve hours a day, and the mean current was 0·5 of an ampère per hour, which six ampère hours = a day, 552 ampère hours for the whole time.

From what has been stated it will be evident that soon secondary batteries will be made the most economical of the three classes of generators considered. In them there is no waste nor trouble due to diffusion of the liquids, as in primary batteries, while they possess all the features necessary for the requirements of the service of large offices. Even while they are being recharged, it would be possible for the circuits to work from the batteries simultaneously.

The only caution we have to exercise is that of preventing the current, in case of a short circuit accidentally occurring from fusing parts of the instruments, or injuring by heat the gutta percha insulation of the leading wires, which run together in large numbers from the battery room to the instrument room. This we can do by constructing the secondary cells with a suitable resistance.

Lastly, it is worthy of notice that a charge of acid does not want renewing. All that is necessary is simply to recharge them electrically.

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(*Continued from page* 384.)

ENCOURAGED by the results obtained in our inland service, we have thought of extending to foreign relations the advantages which the intervention of the post offered to the public for the collecting of money in France.

Eight conventions have successively been signed for that purpose with Switzerland, 6th January, 1880; Belgium, 17th March, 1880; Germany, 24th March, 1880; Luxemburg, 27th March, 1880; Holland, 21st April, 1880; Roumania, 21st May, 1880; Sweden, 30th June, 1880; and Portugal, 26th July, 1880.

Except with a few differences of little importance, we have succeeded in maintaining in those agreements the manner of proceeding as established in France, and to reconcile our own regulations with the principles admitted in the international relations.

The bills are forwarded, as in our inland service, per registered letters, prepaid at the fixed rate of 25 centimes; but, except in the relations with Belgium and Holland, the same envelope may only contain bills, to be recovered from one and the same debtor.

A clause has, however, been inserted in the agreements, except in that with Germany, which authorises the contracting parties to admit later on the right of inserting in one letter bills to be recovered from different debtors by means of one and the same post office.

The maximum sum of the bills to be collected amounts for each letter to 2,000 francs with Belgium, 1,000 francs with Switzerland, Roumania, and Portugal, 500 francs with Germany, Luxemburg, and Sweden, and 300 francs with Holland; but we have also reserved the right to raise the amount of this maximum, without special conventions being required for that purpose.

The rate received for the repayment of the collected sums is the same as the one for ordinary foreign post office orders. Besides, all the conventions give to the office charged with the collecting a remuneration which is exactly equal to the amount of the sums which our regulations allow to the postmaster and to the letter-carrier who do the collecting.

We have also taken care to reserve the right of extending this service to the collecting of protestable bills by a simple agreement with the interested countries, without its being necessary to have recourse to another diplomatic deed. Two recent agreements now allow of exchanging protestable bills between France on the one side, and Germany and Belgium on the other.

Years.	Collected Bills.		Not collected Bills.		Amounts paid to the Treasury.	Amounts paid to Post-masters and Letter Carriers.
	Number	Amount.	Number	Amount.		
		Francs.		Francs.	Francs.	Francs.
1879	285,591	6,708,960.07	137,694	2,788,853.22	96,616.26	43,494.65
1880	1,079,289	27,438,290.75	568,894	11,476,006.85	433,034.21	167,102.65
1881	1,866,683	48,872,360.27	1,070,699	19,301,089.52	679,552.99	296·823.20
1882	2,671,764	75,612,593.41	1,545,540	31,594,145.55	975,344.88	457,578.50
1883	3,836,047	100,431,366.87	1,941,494	39,790,621.60	1,334,510.81	651,142.50
Grand Totals	9,829,374	259,063,571.37	5,264,321	104,951,696.74	3,519,059.15	1,617,140.90

The increase in the number of bills entrusted to the post is shown by comparing the results of 1882 with those of 1880, when we find the following:—

1	to	50	francs, an increase of	150	per cent.	
50	to	100	„	„	„	265 „
100	to	200	„	„	„	247 „
200	to	300	„	„	„	241 „
300	to	400	„	„	„	232 „
400	to	500	„	„	„	225 „
500	to	1,000	„	„	„	277 „

These results are still more striking when we compare them with those that have been obtained in foreign countries. In 1882 the number of commercial bills entrusted to the post amounted, in Germany to 4,085,666, in Belgium to 2,954,232, and in Switzerland to 138,000. During the same year this number amounted in France to 4,300,344.

Thus, in less than four years after it came into force, the service of the collecting of money by the post has reached in France a figure above that of Germany, where it has worked since 1871; of Belgium, where it has existed since 1842; and of Switzerland, where it was created in the year 1875. The average of the bills amounts to 126 francs in Switzerland, 124 francs in Germany, and 121 francs in Belgium; whilst in France it only amounts to 24 francs.

These figures prove that we have attained the aim we were working for. It was not to compete with bankers, but to satisfy special wants, by facilitating the collecting of bills of small amounts, which could not be done but at the cost of considerable expenses.

At the same time that we introduced in France the service of collecting money, we also wished to extend to this country the facilities which the Postal Administrations of foreign countries offered for subscribing to newspapers, especially in Germany, Switzerland, Holland, Austria, Russia, &c.

This service is accomplished in certain countries direct by the post. Thus, in Germany the subscriber pays to the post the amount of the subscription, and a proportional rate of 25 or 12½ per cent., according to whether the newspaper comes out more or less often; the newspapers are then remitted in a lump, without wrappers or addresses, to the post offices charged with distributing them amongst the subscribers.

We could not think of imposing on our offices, burdened as they are already, such an increase in work and responsibility. Indeed, it is not necessary that the post should supersede the Administration of the newspapers to do the service of the subscription. What is of consequence to the public is to be able to subscribe to different newspapers and periodical publications without having to correspond with the publishers.

We have secured them this advantage by means of the following combination:—All our post offices are open to the service of subscribing; the amounts paid by the depositors are converted into post office orders, addressed direct to the publishers. The rate to be paid was fixed in the beginning at 3 per cent. by article 9 of the law of the 5th April, 1879; it had to be paid over and above the amount of the subscription, or to be deducted from the payment, according to the conditions accepted by the publishers.

The new law came into force, in France, on the 1st June, 1879, and in Algeria on the 1st August following; its application produced very good results. From the 1st June till the 31st December of that same year, the number of post office orders for subscriptions amounted to 90,654, the amount of those subscriptions to 1,207,664 francs, the rates paid to 37,410 francs.

We have thought that it was possible to obtain even more satisfactory results, both for the public and the newspapers, by lowering the rate paid for each subscription, a rate which was relatively high. The law of the 17th July, 1881, has enabled us to reduce this rate to 1 per cent., with an addition of a fixed rate of 10 centimes for each subscription, whatever the amount might be. This fixed rate represented the price of a postcard, which the subscriber would at least have had to pay for, should he not have been able to make use of our intervention.

The sacrifice to which the Treasury agreed has rendered the remuneration a mere trifle; the chief point is, that there remains a sufficient profit to pay for the expenses caused by the service of subscribing. This reduction, moreover, has been compensated for by the greater facility offered to the public to subscribe to newspapers and periodical books of all kinds, concerning agriculture, commerce, sciences, literature, in one word, all human knowledge.

The following table shows the results obtained by the service of subscribing to newspapers, &c.:—

Years.	Number of post office orders.	Amount of post office orders.	Rates received.
1879	90,654	1,207,664.35	*37,410.16
1880	186,211	2,169,792.71	†54,758.52
1881	237,869	2,638,267.20	51,002.59
1882	257,539	2,706,605.55	53,864.92
1883	269,178	2,801,318.02	55,403.43
Totals ...	1,041,451	11,523,647.83	252,439.62

As the service of subscribing to newspapers by means of the post was introduced in France, the same as that of collecting money, after it had been adopted by neighbouring nations we tried of course to extend it to our international relations.

And we have succeeded in this.

From the 21st November, 1879, an agreement was made to that effect between France and Belgium.

Similar conventions have since been signed with Denmark (19th June, 1880), Italy (9th June, 1880), Norway (29th October, 1880), Holland (19th March, 1880), Portugal, 28th April, 1880), Sweden (30th June, 1880), Switzerland (6th January, 1880).

These conventions sanction the right of receiving in the French post offices subscriptions for newspapers and periodicals published

* Service opened on the 1st June, 1879.

† From the 1st August, 1880, lowering of the rate from 3 to 1 per cent., plus a fixed rate of 10 centimes per subscription.

in the before-mentioned countries, and in the offices of those countries subscriptions for the French publications.

The Government has preoccupied itself to arrange the working of those agreements, conformably with the inland rules fixed for the service of subscribing by the law of the 7th April, 1879, and with the regulations which are at present in force for the service of international post office orders.

According to our inland service, the rate of the commission is deducted from the amount of the subscription or charged in excess to that price, according to the conditions, made to that effect with the publishers.

This rate for international subscriptions amounts to 3 per cent., the same as the rate fixed by the law of the 5th April, 1879.

The agreements made with foreign administrations reserve however, to the contracting parties the right of adopting, without having recourse to another diplomatic act, a tariff below this 3 per cent. whenever they should think it convenient to do so, and the laws which have approved of these conventions, allow us, within the stated limits, to introduce those alterations by simple decrees.

The rate of the commission can never be less than 25 centimes. This figure represents the amount of the postage of the letter, which the subscriber, when once the request has been received in a post office, can dispense with. In the relations with Switzerland, this minimum is exceptionally fixed at 50 centimes.

The rate received is equally divided between the office of origin and the office of destination. This equality of division is, moreover, in keeping with the regulations relating to foreign post office orders.

To sum up we have succeeded in maintaining in all the conventions concluded with foreign administrations the regulations in force for our inland service of subscribing. We have even succeeded in making them prevail in the relations with certain countries, such as Belgium and Switzerland, where this service is organised according to different principles.

Finally, we have the satisfaction of having contributed to the establishment of this service, which did not yet exist in Portugal; it is, indeed, only after having concluded the convention with France, that Portugal has established the service of subscribing through the medium of the post, in its inland service.

(*To be continued.*)

REVIEW.

Exercises in Electrical and Magnetic Measurement. By R. E. DAY, M.A. New Edition. London: Longmans, Green & Co.

In the new edition of his work Mr. Day has effected several improvements which have greatly added to its utility. Books of the kind are much wanted, and there is plenty of scope for them. The author has thoroughly recognised that "numerical exercises are necessary in the study of the experimental sciences, both as giving practice in the application of the various theories, and as affording tests of ability to comprehend, as well as to apply, that which has been learned," and he states that this is now "universally admitted." That it ought to be so we quite agree; but we greatly doubt whether it is. Teachers, for some occult reason, cannot, as a very general rule, recognise the fact that what is quite clear to themselves is not necessarily clear to others, and that algebraical symbols, unless explained by the help of numerals, but very slowly convey their true significance to the brains of many workers. As Mr. Day most truly points out, "a thorough grasp and realisation of the meaning of a formula in physics can scarcely be acquired from lectures, or from seeing it in the form of algebraical symbols in a text-book, whereas the working out by the student himself of its application to a single concrete case is often sufficient to make him feel confidence in using it, and to give precision to ideas which would otherwise remain floating in his mind in a vague and comparatively useless form." The book, as might be inferred, consists of a collection of questions on electrical matters with their answers. These questions are most judiciously chosen, and their solution is given in a way which will gladden the heart of many a student. Amongst other examples, we have a straightforward working out of that mysterious number, ·175; namely, the "horizontal intensity of the earth's magnetism," a number which has puzzled many learners, and for which the latter have sought in vain for an explanation in the existing text-books of science. Altogether, we consider that Mr. Day has done a most distinct service in bringing out "Exercises in Electrical and Magnetic Measurements," and we heartily recommend all students in electrical science to purchase a copy of the same.

THE ELECTRIC LIGHTING ACT.

DEPUTATION TO THE PRESIDENT OF THE BOARD OF TRADE.

ON Thursday afternoon an influential deputation of directors of electric lighting companies and others prominently connected with electric lighting, attended upon the President of the Board of Trade (the Right Hon. Joseph Chamberlain), at 7, Whitehall Gardens, with the purpose of pointing out the difficulties of working under the Electric Lighting Act. Amongst these were Lord Thurlow, Lord Anson, Sir Frederick Bramwell, Sir Daniel Cooper, Dr. Farquharson, M.P., Messrs. J. S. Forbes, R. Hammond, J. S. Sellon, R. E. Crompton, E. Woods, A. Saumarez, J. B. Braithwaite, jun., J. Irving Courtenay, P. Cremien-Javal, D. H. Cothill, F. Wynne, S. F. Page, E. Garcke, G. Offor, A. Renshaw, Herbert Gibbs, J. Dixon Gibbs, and Conrad Cooke.

The following is a memorandum of the objects desired by the deputation:—1. In the opinion of the deputation the rights given to the local authorities to purchase compulsorily electric lighting undertakings within their districts upon the terms set forth in section 27 of the Electric Lighting Act are such as prohibit any supply of electric light to the public; and such clause should be repealed. 2. In the Provisional Orders granted by the Board of Trade under the Act, the provisions as to the compulsory laying down of mains should be omitted; and the undertakers should have full power to decide as to the position and extent of the mains to be laid down by them; the right to compel the undertakers to supply them with the electric light should be confined to consumers willing to take a minimum supply per annum. 3. The undertakers should be permitted to supply otherwise than by meter, and in such cases the purposes to which electricity is applied by the consumers should be matter for agreement between them and the undertakers.

Lord Thurlow having introduced the deputation,

Sir Frederick Bramwell said he felt the subject was a very important one and he should have liked to dilate upon it somewhat, but as Mr. Chamberlain had intimated his desire that the proceedings should be brief, he would endeavour to comply. He was there as a shareholder in the Edison and Swan Company, and therefore had a direct interest in the matter; and moreover he was consulted by many parties at the time the Bill was passing through Committee, and he was asked to give evidence of his views to the Committee. He took a great interest in the passage of the Bill then, and had taken great interest in the working, or non-working, of the Act since. The subject was undoubtedly one of the most important, relating to an illuminant now well known by its application to steamboats, private installations, and theatrical installations, and it must be confessed that wherever the electric light—the glow-light—was used it had given the greatest satisfaction; it had only to be tested to be appreciated, and it was desirable, for various reasons, that it should not be out of the reach of those who wished to have it. On sanitary grounds, in regard to the diminution of heat, the non-vitiation of the air; on the grounds of the preservation of pictures, books, and furniture, cleanliness of walls and ceilings, it was highly desirable; and being so, many people would be willing to pay for it if it could be supplied to them. It could be obtained, no doubt, by independent installations—was so obtained, in fact; but there were many objections to that, and most people would prefer to have it as gas and water were supplied. It had been agreed, during the last 50 years at all events, that the material progress of the world was dependent upon the application of science, and he did not know a more meritorious application of science than that of electric lighting. It was only a few years ago that it was said to be impossible to divide the electric light and to use any number of lamps; but now lamps were put in at the will of the person using them, and they were perfectly under control. At present, unhappily, there was a great depression of trade, and a considerable want of employment among the working classes; and but for the restrictions imposed upon it this industry would prove a new means for the outlay of capital, and orders would be given to the factories now in want of them. Another point was our coal supply, which ought to be husbanded. A dynamo would give the same amount of light for about one-third or one-fourth the quantity of coal required for the ordinary illuminant, gas; this applied to the glow-lamps, but when the arc light was used, only one-twentieth the amount required for gas was needed. Up to 1882, many persons had hoped that there would be a very rapid development of this mode of lighting for public purposes. He himself had entertained that hope, and became a shareholder to the extent of £5,000 in the Edison Company. When he learnt the provisions of the Bill, however, he knew that it was calculated to defeat the objects of those who had the electric light in hand. He stated his views to the Committee, and did his best to have the conditions of the Bill altered, but without much success. In spite of the difficulty of getting capital to go into new undertakings, he believed there was a sufficient number of

men willing to embark their capital, and to urge the thing somewhat; even if it were without immediate profit, still, to be the pioneers of this mode of lighting, they would have gone on, and the matter would have been fairly tested, but for this Act. As it was, he thought he was right in saying that those hopes had been entirely disappointed, and that there was now no provision in England—practically none, if not absolutely so—for the distribution of the light to private consumers from a central source of supply. The effect of section 27 was, that at the expiration of 21 years the local authority would have the option of compulsory purchase of the undertaking, for which it was not to pay anything "in respect of compulsory purchase or of goodwill, or of any profits which may or might have been, or be made, from the undertaking, or of any similar considerations." But they were to pay "the then value of all lands, buildings, works, materials and plant of such undertakers." Upon that the utmost life given to electric light undertakings was 21 years, the earlier years of which period had been passed in strenuous efforts to get the electric light taken up to such an extent as to pay working expenses. It seemed to him impossible to induce capital to come into these undertakings, if at the end of those years, if the thing were a success, the local authority would come in and reap all the benefit; they might be sure that if it did not pay they would not come in. It was inevitable in an industry of this kind that during those years there would be need to replace the earlier plant put down by other and newer plant. This, he submitted was a fair charge to come upon capital. Supposing that at the end of ten years a need arose for new capital, and an opportunity for earning a dividend upon it, the prospect of the compulsory sale of the concern upon the terms of the Act at the end of eleven years would prevent anyone from subscribing, and a promising enterprise would be strangled for want of capital. Under the conditions of the Act, all persons in the district lighted were entitled to call upon the company to give a supply; it was true they were bound to guarantee for three years a certain return, but still this would insist upon the undertakers' finding new plant at the time the requisition was made. This might have to be found at any time; and under these circumstances no one would embark capital. It appeared to him that the clause was absolutely prohibitory of getting capital invested in this kind of undertaking. He asked, was it not desirable that the public should have the power to obtain the illuminant in houses in some such way as gas was obtained? And by the simple admission of two terminals into a house this could be done. Was it not desirable that there should be competition upon fair terms with the gas companies? He would ask, too, whether it was right that electric lighting companies should be weighted with restrictions which were never imposed upon the companies with which they had to compete. He trusted that on consideration the President of the Board of Trade would see his way to repeal so much of the Act as was embraced in Section 27.

Mr. Chamberlain said he had had correspondence with some of the companies, who in their communications had not asked for an absolute repeal of the clause, but for a modification of it, which was quite a different thing; and he wished to know whether Sir Frederick Bramwell spoke for all present in asking for an absolute repeal.

Sir Frederick Bramwell said it might be that there had been persons who did not expect to get a repeal; but he was quite sure that those who had asked for the modification would be only too glad to have a repeal.

Mr. J. S. Forbes, Mr. R. E. Crompton, and Mr. R. Hammond, spoke in support of the arguments adduced by Sir Frederick Bramwell, the hardships in connection with the requirements of the Provisional Orders regarding the laying of mains and the constant and compulsory supply of light being also dealt with.

Mr. Chamberlain, in reply, observed that he must say at once that they were so far agreed that the Board of Trade was as anxious as they could possibly be for the development of this important enterprise. He recognised the truth of what Sir Frederick Bramwell had said on that part of the question, and if there was anything in the legislation of the past two years which unduly and unnecessarily interfered with its development he would be most happy to hear how it could be amended. He understood their views to be that the small progress made was entirely due to that legislation. He did not want to enter upon contentious subjects, but must express his opinion that it was due, in a great measure, to the great haste on the part of companies which had been more or less financial speculations. A few years ago these companies came to Parliament and proposed, practically, to parcel out the whole country among them, at a time when, according to the statements made that day, they knew so little of the matter that what they purchased for £2,000 eventually was discovered not to be worth more than £200; and when generally the whole matter was in an empirical condition, which could not form the basis of a really sound commercial enterprise. Under such circumstances it certainly seemed to him that it was the duty of Parliament to prevent the appropriation of this great business by companies which were not really prepared to deal with it in a practical way. As they knew, a Committee of the House of Commons was appointed for the purpose of considering the whole matter. That committee was generally admitted to be a very able and impartial committee; it came to a practically unanimous conclusion, and the Act now complained of was the result of its deliberations; the Act was somewhat amended in the House of Lords, to the extent of substituting 21 years for 15 before the right of purchase arose. The intention of the committee undoubtedly was to prevent the creation of those vast monopolies which in the case of gas and water had sprung up in a way that was felt to be inconsistent with the true advantage of the community; at the same time the object was not unnecessarily to interfere with the progress of the industry. Sir Frederick Bramwell had omitted to mention that gas was under very considerable limitations; although no attempt was made to prevent the monopoly, there was an attempt made to limit it in regard to dividends; the object was the same, though obtained by different means. Several speakers had said there was no similar cases of restrictions to those applying to electric light; but that was a mistake. It was precisely the same in the case of the tramways, for, with the same view, in the Tramways Act a clause was inserted which enabled local authorities to purchase at the end of 21 years. He would admit at once, that in regard to methods and details there were matters fairly open to consideration. He should say that the object of the 27th clause was that while the community might be enabled to resume the monopoly at any moment after 21 years, it could only do so on terms which should, at all events, fairly recoup the undertakers for all legitimate outlay. It might be, however, that the terms did not carry out the object. If that were so, all he could say was that if they would be good enough to draw up such a modification of the clauses as would, in their opinion, satisfy those who would require to work under the Act, he would give it consideration. He might say that he could not give any support whatever to a proposal that the whole of the clause should be repealed. He did not think that the local authorities of the country would assent to any proposal of that kind, and he could not think that Parliament, which was hostile to these great monopolies, would allow a new one to spring up in the case of the electric light unguarded and unlimited by conditions of that kind. In regard to minor matters, he admitted there were subjects for further consideration, and he would be very glad to have any proposals from them. A concession, he considered, was a practical monopoly, and must carry with it corresponding obligations; these might be a little too stringent in this case, and if so, he would be glad to know the exact measure in which they would have them modified. He thought these obligations were somewhat misunderstood, both in regard to the questions of compulsory and of constant supply; he did not understand in the latter case that the obligation was absolute. He understood that if the constant supply were not given, the undertakers might be liable to a fine, but it would be open to them to show the reason why they had been unable to comply with the obligation to give a constant supply, and in that case the fine would be released, or would be purely nominal. He agreed entirely with the last point urged, that greater power should be given to local authorities; he did not like such a burden of duties cast upon him, and thought that a modified form of home rule on the part of the local authorities would act beneficially. The practical conclusion of the whole matter was this—that he could not give them any hope that he would himself favour a proposal for the absolute repeal of the 27th clause, but he would give his best consideration to any proposals they might make, in the form of clauses, for the modification of that clause, or any other provisions they thought necessary.

Sir Daniel Cooper having expressed thanks for the promises of consideration given by the President of the Board of Trade, the deputation withdrew.

NOTES.

Electric Lighting.—It is contemplated, we understand, to make another experiment in electric lighting at the Mansion House during the term of office of the new Lord Mayor, Mr. Alderman Nottage.

The Commissioners have rejected the high-light projecting system with which the Brush Swan Electric Light Company, of Washington, U. S. A., had for 45 days lighted the principal thoroughfare of the city experimentally, and gas has been re-installed.

The Central Marine Engineering Works of West Hartlepool having purchased from Messrs. Gray and Gladstone of the same town their Brush 16-light apparatus, have entrusted the erection of it to the Hammond Electric Light and Power Supply Company, Limited.

For several years the Director of Telegraphs at Haugesund (Norway), Herr A. Reitan, has been making experiments for the purpose of solving the problem whether fish seek places in the sea which are artificially illuminated. In order, however, states *Nature*, to make experiments on a larger scale than hitherto, and if possible to demonstrate the value of such illuminations at great fisheries, he has received some specially-con-

structed electric lamps from Brussels, with which he will continue his experiments during the autumn.

Judging from their contracts made for street lighting in several cities of Canada, the electric light companies, says the St. John N. B. *Telegraph*, are acting on the principle of getting what they can for the work. Winnipeg has a contract for electric lighting under which it pays about $1.25 per lamp per night for thirty nights. Toronto, for lighting a portion of its streets, pays about half as much per lamp. Ottawa has made an agreement on much more favourable conditions for lighting the streets of the entire city at 22 cents per lamp per night. In the latter case it is to be remarked that abundant water power is to be credited, in part at least, with the low rate. Still the difference is so great as to leave a doubt in the minds of the public as to what is the actual cost to the producers of electric lighting. The difference between the extremes is much greater than in gas. The one hopeful symptom to consumers is that the latest contract, that of Ottawa, shows by far the cheapest rate.

The new first-class ironclad, the *Ruggiero di Lauriá*, of the Italian navy, has been provided with a complete electric light installation, comprising arc regulators and incandescent lamps furnished with the Mangin projectors. The dynamos were made at the Government workshops at Spezzia, where all the electrical machinery for the Government is constructed.

The French Edison Company has lately put down plant for lighting the Cosmydor Soap Works, at Levallois-Perrett, a suburb of Paris, with 50 A lamps ; the works of the French Linoleum Company, at Olry, with 100 A lamps ; the Hyat and Ward celluloid factory at Monville, near Rouen, with 100 lamps ; the Grande Chartreuse Distillery ; the Montgolfier Paper Mills ; the Lemaire-Dellis Spinning Mills ; and the Bucharest Theatre, with 1,500 Edison incandescent lamps. This installation has been ordered by the Bucharest Gas Company, to which the work was intrusted ; while the Lemaire-Dellis Spinning Mills, which were totally destroyed by fire due to gas, have been re-erected without any provision for that illuminant. Besides their own installation, the proprietors have put down plant for maintaining 500 incandescent lamps for their neighbours. The Edison Company is now making small dynamos for running 20 6-candle lamps. In the installation lately put down by this company for Hachette's publishing house in Paris, the three dynamos (one for 200 lamps and two for 60 lamps each) are arranged so that they can supply current to each other's circuit in case of breakdown in one of them.

It is said that the Vienna Municipality wishes to adopt the electric light at the new Rath-haus, but that the conditions are such that they prevent any electrician from tendering for the installation.

Mr. Jamieson's paper on "Electric Lighting for Steamships," read at the Institution of Civil Engineers on the 7th inst., was the subject of discussion at that Institution last Tesday evening, and will be still further considered at the next meeting, to take place on Tuesday, the 25th inst.

On Wednesday Messrs. John Elder & Co. launched from their shipbuilding yard, at Fairfield, Govan, a steel screw-steamer for the New Zealand Shipping Company, Limited, of London. The vessel is intended for the direct service from London to New Zealand. This steamer is a sister ship to the ss. *Kaikowa*, launched by Messrs. Elder on the 8th September last. The saloons, entrances, corridors, ladies' room, smoking room, card room, state rooms, engine and boiler rooms are all fitted throughout with incandescent electric lamps.

Telephonic.—We are officially informed that the long-pending dispute being the National Telephone Company, Limited, and Messrs. D. and G. Graham has now been amicably settled. Arrangements have also been made whereby the telephone company now executes all the work in the Glasgow district for which Messrs. D. and G. Graham have hitherto been the contractors ; and in consequence the company has now the whole of their construction and maintenance work under its own control throughout all the territory it occupies.

The Telephone for Divers.—In raising the vessel *La Provence*, which sank in the Bosphorus, the telephone was added to the diver's dress, thus greatly facilitating the communications. One of the glasses of the helmet is replaced by a copper plate, in which a telephone is inserted, so that the diver has only to turn his head slightly in order to receive his instructions and report what he sees. Besides, in case of danger or accident, lives may now be saved which would otherwise have been sacrificed.

Telephone Extension in Scotland.—The National Telephone Company, Limited, of Glasgow, has opened up communication between Glasgow and Paisley, Greenock, and Edinburgh, and intends to at once extend its system to Hamilton, Coatbridge, Dumbarton, Falkirk, Grangemouth, and Bo'ness. Very shortly subscribers will be able to receive telegrams from and transmit them to the post office department. Another excellent innovation will be the liberty that is shortly to be given to non-subscribers to use the telephone in Glasgow, both to subscribers in the city and to those in the outlying towns. A small fee will be charged for this.

The Utility of the Telephone.—In Paisley last week the telephone was twice in requisition for calling the fire brigade. In one instance the brigade was notified by telephone of a fire, and arrived on the scene two minutes later. It was also largely due to the telephone that the fire at Coats's dye works did not assume larger proportions. The brigade was called by the local telephone exchange, and arrived at the works seven minutes afterwards.

The Proposed Telephonic Exchange in Perth.—Last week a meeting of merchants and others interested in the introduction of a telephonic exchange in Perth was held in the Guild Hall to hear the report of the committee appointed, and to take such action therein as might be deemed advisable. The proceedings were conducted in private, but we understand that statements were submitted by both companies, and were read to the meeting by Lord Provost Martin. After discussion, ex-Bailie M'Kenzie moved that, having considered the advantages especially conferred by the National Telephone Company, the meeting agree to recommend that company alone for the acceptance of the citizens of Perth to form a telephonic exchange, and the motion was carried by a majority of 12 to 10. The committee was re-appointed to see the agreement with the National Company legally ratified. We understand that the National Telephone Company is prepared to admit subscribers to the Perth Exchange on a payment of £7 10s per annum up till February 1st, and that the subscription for those who join after that date will be £10. The subscription for the trunk wire between Perth and Dundee will be £7 10s. The agreement will be binding for seven years.

United Telephone Company, Limited.—This company is promoting a Bill applying for various powers in extension of those it already possesses. Briefly, the objects sought are :—Powers to carry wires for telephonic communication over, along, or across any highways, streets, footpaths, or other public places, and any houses or lands within 100 miles of the General Post Office ; powers to vestries and other public bodies and companies to enter into agreements for facilitating telephonic communication ; powers to break up streets, erect posts on, and lay or carry wires for telephonic communication under or over any land, house, street, or other place within the limits aforesaid ; powers of supervision to Board of Trade, or other public authority ;

if so determined, to dissolve the company and to incorporate the shareholders of the dissolved company with other and extended powers; to authorise the granting of licenses, and for other purposes; incorporation and amendment of Acts.

Telephone Litigation in America.—The Examiners in Chief of the Patent Office, Washington, in the celebrated telephonic interference patent case, have sustained the decision of the Examiner of Interferences in favour of Bell, which will be found in the REVIEW of August 11th, 1883, as to issues A, B, C, E, F, I, J, and L, and have reversed the decision so far as it applied to issue "G" (which involves the principal feature of the telephone), which was awarded to McDonough, and which the Examiners in Chief have decided in Bell's favour. The Examiners have also rendered their decision in the matter of Voelker *v* Gray *et al.*, a patent interference case involving the invention of the speaking telephone. Of the fourteen original parties there remain now only six, viz., Wm. L. Voelker (two applications), Thos. A. Edison (five applications), Elisha Gray (four applications), John H. Irwin, James W. McDonough (one application each), and Alexander Graham Bell (two patents). The Examiner of Interferences had awarded priority of invention to Bell in cases A, B, C, E, F, I, J, and L, and in cases "D" and "No. 1" to Edison, and in case "G" to McDonough. Case "G" is an application for "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality."

Bell and Drawbaugh.—Mr. Henry C. Andrews, the attorney for Drawbaugh's syndicate, writes to the New York *Mail* and *Express* of the 10th inst., as follows:—In an editorial in your issue of yesterday, headed, "The Late Telephone Decision," it is stated that "it is generally known that in the latest litigation Alexander Graham Bell was awarded priority on all of the essential points as against one Daniel Drawbaugh." Then follow certain statements of alleged "evidence" in regard to Drawbaugh, apparently taken from an article in the last number of an electrical journal, published in the Bell interest, and edited by the expert of that company. There has been no decision in the Patent Office in favour of Bell against Drawbaugh. There is no decision pending there as between those parties. No evidence has been taken in any controversy in the Patent Office as between Bell and Drawbaugh. A decision was recently rendered by the Board of Examiners in Chief in the interference case of Voelkner *v.* Gray, in which the parties claimant were Voelkner, Gray, Edison, Irwin, McDonough, and Bell. In this matter Bell was declared to be prior to all these mentioned, but Drawbaugh was not a party to this proceeding. The only decision that has ever been rendered by any court or tribunal on the merits of the issues between Bell and Drawbaugh was by three judges sitting at a circuit court of the United States in a suit and motion for an injunction brought by the Bell Company against the Overland Telephone Company, in which the injunction asked by the Bell Company was refused on the strength of the Drawbaugh evidence. All the issues between Bell and Drawbaugh were argued at length at the last October term of the U.S. Circuit Court in this circuit, where a decision is still pending, and as this will be the best answer to the misstatements of facts and evidence so industriously circulated by the Bell Company for purposes best known to itself, Mr. Drawbaugh can afford to await with complacency a vindication of himself and friends at the hands of the court.

The Mackay-Bennett Cables.—We observe that a company has been organised to lay a cable from Brazil to New Orleans, *via* St. Thomas, to cost $3,000,000, which will work in connection with the Mackay-Bennett cables.

Cable between Nova Scotia and Sable Island.—The Dominion Government will place the sum of $140,000 in the estimate during the coming session of Parliament to defray the expense of laying a cable between Nova Scotia and Sable Island. Owing to the rocky nature of the bottom over which the cable will run, states the New York *Electrical World*, it will be necessary to lay a shore end type the whole distance, which will cost three times as much as an ordinary ocean cable.

The Telegraph in Canada.—The report of the Public Works Department points out that Canada possesses greater telegraph facilities than either the United States or any European country. The number of offices in Canada is 2,259, or one to every 1,914 of population, while in Switzerland the proportion is one to 2,500; in the United States, one to every 3,700; in Germany, one to every 4,300; in France, one to every 6,231; and in Great Britain one to every 6,508.

Telegraph Revenue.—The receipts from April 1st to November 15th, 1884, amounted to £1,150,000; from April 1st to November 17th, 1883, the receipts were £1,145,000.

Telegraph Wires and Owners' Rights.—The tribunals of Philadelphia have decided that the proprietor of a house has the right to cut telegraph wires which have been placed above his house without his consent previously obtained.

Telegraph Materials Wanted.—The Cheshire Lines Committee are prepared to receive tenders for the supply, during the year 1885, of telegraph materials, instruments, &c.

Electrical Car at Philadelphia.—Upon the last day of the Exhibition at Philadelphia an experimental electrical street car was run upon Thirty-second Street for the first time. This car is the invention of Mr. W. W. Griscom. The current is carried by a third or middle rail, and the method of connection is by brushes rubbing along the rail. The motor of this street car is a 15 horse-power Griscom motor, differing, however, from the other Griscom motors in using an armature composed of a modified Gramme ring instead of Siemens' armature. The current is derived from the Weston incandescent lamp dynamo machine. The test was very successful, the machine starting, stopping, and reversing easily.

Electrical Nomenclature.—Among the speakers, says the *Mechanical World*, at the National Conference of Electricians in Philadelphia, was a most prominent English electrician who instructed his audience in this wise:—"In a sperm candle, for one candle light we expend 97 watts . . . with gas, for every candle given out 62 watts were consumed." It says much for the politeness of our cousins that they suppressed their smiles. Evidently the speaker has a most confused idea of the "Watt," which apparently may be expended or consumed like gunpowder, and yet the Watt is a unit with which he should be as familiar as with the inch or pound. It is time to protest, as we have done over and over again, against the absurd practice into which electricians have fallen, of disgracing their departed superiors by fastening their surnames to quantities for which descriptive names could easily be found. Why should not chemists adopt the same practice if it possessed a single argument in its favour, or why should not mechanics call the foot-pound a Tredgold, the pound-degree a Whitworth, or the unit of pressure and area a Stephenson? This is precisely what the electricians have done, and some of their statements read just as absurdly as would "one hundred Stephensons will burst the boiler;" or, "if we oxidise a Roscoe we produce a Cavendish;" or "a vessel of Smithic capacity will hold one thousand Joneses."

The Proposed Electric Tramway from Bessbrook to Newry.—We read in the *Mechanical World* that the permanent works in connection with the construction of this line of tramway are being pushed on with great energy by the promoters (the Bessbrook Spinning Company). The extensive buildings at Millvale in which the turbine and the dynamos will be placed are nearly finished. Large masses of granite, some of which weigh six tons, are lying close to the building, and some are already laid in the floor of the shed and at the bottom of the mill-race. The turbine water wheel, 86-horse power, has just arrived from the works of the makers, M'Adams, of Belfast, and the electrical machinery is expected in a few days.

The "Great Eastern."—As we recently stated, the *Great Eastern* is to be sent to the New Orleans Exhibition. She will leave Milford Haven about the 29th inst., and will be moored alongside the exhibition grounds as an exhibit and floating hotel, until May next. Goods forwarded by the *Great Eastern* will be allowed to remain on board until sold, without extra charge. The ship will be extensively lighted with arc and incandescence lights.

The Glasgow Fire Alarms.—An extraordinary scene was witnessed in Glasgow, last Saturday afternoon, at a fire which broke out in the Colosseum. On observing the outbreak the electric fire alarm, close at hand, was used without effect, and the fire brigade had to be summoned from the Southern Police Station. After a delay of about 20 minutes the brigade appeared, and was received with hoots and hisses from a large and excited crowd, ignorant of the cause of the delay. It appears that on the previous Monday the apparatus had been examined by the firemaster and found to be in good order, but one-third of the alarms were found to be faulty.

At the Town Council meeting on Monday, it was stated that the person who had got the testing of the fire alarms for the current year was only appointed at the last meeting, and that he had reported several of the alarms "considerably out of gear." One member said: "In the Council it was constantly being forced upon them that they must take the lowest offer for these things, and the result of that was that they could not get the attention that they ought to receive."

Legal.—In the Court of Session, Edinburgh, on the 12th inst., the case of Muir *v.* Stockman was heard. William Campbell Muir, of Inistrynich House, Argyllshire, contracted with B. S. Stockman, C.E., Poet's Corner, London, to fit up an installation of electric light at Inistrynich. The electric lighting proved a failure, and in this action Mr. Muir sought to recover £58 16s. as board and lodging for defender and his son during their stay at pursuer's house. Lord Fraser assoilzied defender from this conclusion. Whilst the work was going on defender had the assistance of a plumber named Brydon, and pursuer sought to recover the sum of £28 as the value of work done by him, and for which pursuer had paid, with the exception of the sum of £3 10s. 2d. This claim was also disallowed; whilst a claim for £100 in respect of damages done by defender to the electric cable was reduced to £15. For these two sums of £15 and £3 10s. 2d. his Lordship decerned against defender, and found neither party entitled to expenses.

The Society of Telegraph Engineers and Electricians. — Through the courtesy of the Eastern and the Eastern Extension Telegraph Companies, the fact of Mr. Edward Davy's election as an honorary member of the Society of Telegraph Engineers and Electricians was communicated to him by wire, and we understand that by the same means Mr. Davy (from Australia) has been able to express to the Society his high appreciation of the honour thus conferred upon him.

Electrical Patents.—In last Saturday's list of published specifications issued by the Patent Office, we were surprised by the absence of any patent relating to electrical matters. This, of late years, has been of most rare occurrence.

The Life of Incandescence Lamps.—We have been informed that it is believed in certain quarters that the lamps to which we referred in our leading article of November 1st as having been rapidly destroyed even when worked below the normal E. M. F., are those of Messrs. Woodhouse and Rawson. This, however, is not correct, the lamps being of quite another manufacture.

Society of Arts.—Among the papers to be read during the ensuing session of the Society, is one by Mr. W. H. Preece, F.R.S., on "Electric lighting in America." The third course of Cantor Lectures will be by Prof. George Forbes on "The Distribution of Electricity."

More Units.—Says the *Mechanical World*:—"Prof. Sylvanus Thompson is the last in the field with the 'gauss' which is the unit of measure of the intensity of a magnetic field. The working electrician has quite enough to exasperate him at present, without being driven absolutely mad by having to answer how many gausses his field magnets develop, how many watts his dynamo yields, what is the faradic capacity of his leads, what their conductivity in mhos, how many coulombs his accumulator holds, and other equally sensible enquiries. We wonder with all their ingenuity how it is that the class-room electricians have not found that a new unit of light duration is essential to their happiness."

Lecture.—Last Monday week Mr. Reckenzaun gave a lecture, with experiments, at College Chapel, Stepney, "On the Application of Electricity as a Motive Power." He gave a short history of electro motors, the principles involved in their construction: explained the first practical installation for the transmission of power at the Vienna Exhibition of 1873, by Fontaine and Gramme; the small electric railway at the Berlin Exhibition, by Siemens, in 1879; those of Lichterfeld and Paris in 1881; and the applications of electricity to hoisting machines, citing almost every example of which published data was available. He went on with a short sketch of Prof. Jenkin's system of telpherage, and proceeded with the most recent examples—the electric railways of Messrs. Siemens at Portrush, Magnus Volk's at Brighton, and Holroyd Smith's at Halifax. Electric launches for pleasure and war purposes formed part of the subject, and in conclusion the lecturer dwelt upon a system of the distribution of motive power by electricity in densely populated industrial centres, where workmen have to carry on their trade in their own homes, where steam power and even gas engines are beyond their reach, in places where a small amount of mechanical power would prove of immense value to operatives if it could be supplied at a few pence per horse-power hour.

Electrical Railways.—We note that the promoters of the Charing Cross and Waterloo Electric Railway, which was sanctioned by Parliament in 1882 for the purpose of constructing an electric railway from Waterloo Station, passing under the River Thames to Northumberland Avenue, have decided to abandon the authorised railway, and to dissolve the Company.

Transmission of Power.—The Creil experiments (for which a sum of £20,000 has been set apart) for the transmission of 100 horse power through an electric conductor, have been deferred, in order to permit of every possible precaution being taken to ensure success. Those concerned in the installation have consented to accept only the bare reimbursement for their outlay.

Electrical Engineering.—The subject of the lecture with which Professor Fleeming Jenkin opened his class at the Edinburgh University was "Electrical Engineering." He said it seemed to him that electrical engineering at the present day was only in the position in which railway engineering might be said to have been shortly after the opening of the first railway by Stephenson. Looking back over the last 16 years, they could not observe any great advance in telegraphy, though, at the same time, that period had witnessed the introduction of the telephone—in regard to which, he might remark, England had been immensely hampered by legislation. In electrical engineering, however, much greater advance had been made by the discoveries of Graham Bell and Edison, and also by the development of what was called the "dynamo" machine. Having traced the gradual development of the "dynamo"—pointing out in passing the part which the Italian Pacinotti played in that development, together with Gramme—and having also commented on the improvements which had been effected in the construction of electric lamps, the lecturer went on to speak of the transmission of electric energy, and of the conversion of the electric current into mechanical power. There was, he said, practically no limit to the distance to which electric power could be transmitted, and the divisibility of that power was calculated to make very great revolutions in engineering practice. If any great loss of power were involved in that transmission, it would, of course, form a serious drawback; but, as a matter of fact, there was not necessarily any great loss of power. Still, these advances had not been due to men of Science so much as to men of commerce. There had not been one single principle of any importance discovered since the days of Faraday; and he would make bold to say that there were not likely to be any important discoveries hereafter. Theories would be perfected, but the enormous advances made in its early years could not be repeated. At this moment the science of electricity might, perhaps, be considered as one of the most, if not the most, exact that we had, owing to the accuracy with which its propositions admitted of being measured. The electric light was popularly looked upon as a failure; but what was the cause of this? Because, in the first place, an absurd rush had been made on every electric invention brought forward, whether meritorious or not, and large quantities of money had been lost on them, so that now the whole commercial world simply hated the word "electricity"—(laughter)—and, in the second place, because of mistaken legislation, which must before long be modified. But the present standstill in regard to that use of electricity was, he felt convinced, really only temporary.

Balloon Steering.—A third experiment in balloon steering was made on Saturday the 8th inst., by Captains Renard and Krebs at Meudon, and is said to have resulted in a complete success. The aeronauts went as far as Billancourt and returned to Meudon, descending at the spot whence they started. The voyage occupied three-quarters of an hour.

A German engineer claims to have discovered a means of condensing or expanding the gas in a balloon by the use of carbonic acid. By this discovery not only can the aeronaut ascend and descend until he finds a suitable air-current, but in war time a balloon may enter the enemy's territory and leave again without requiring a fresh supply of gas.

The "World's Exposition" at New Orleans.—We have received a circular issued by the United States Consulate General, calling attention to the fact that the Department of State at Washington proposes to make a commercial exhibit at the New Orleans Exhibition, and asking for contributions in the form of donations or loans of articles which will best illustrate the present condition of the world's trade.

Inventors' Institute.—At a meeting of the Executive Council on Monday, it was resolved "That the first meeting in every month should be devoted to the consideration of the Patents, Designs, and Trade Marks Act in 1883, that the Act should be gone through regularly by sections, and that a report should be drawn up of the result of the discussions, and that visitors should be invited to attend these meetings." The Executive Council then proceeded to elect new members. The first meeting for the consideration of the Act will take place on Monday, December 8th. The chair will be taken at 8 p.m. by Vice-President Admiral Selwyn, when Parts I. and II. as far as Section 7, should time permit, will be discussed. The Secretary is authorised to issue a few tickets of admission.

The New Postmaster-General.—*Vanity Fair* says:—I hear that Mr. G. Shaw-Lefevre, the Commissioner of Public Works, is about to be appointed Postmaster-General. Perhaps in the Post Office he may be able to expedite the time when we shall be allowed to use the telephone, to send sixpenny telegrams, and to wind up the disastrous business of the parcels post.

International Health Exhibition.—Under we give copies (obverse and reverse) of the medal awarded to successful exhibitors at the Health Exhibition. We

print from electrotype copies of blocks engraved by Messrs. Barker & Son, 172, Strand.

Fire Alarms for Greenock.—We understand that the erection of electric fire alarms throughout Greenock is at present engaging the attention of the Town Council.

Demise of Mr. F. J. Smith.—We are informed that we were in error in announcing the death of Mr. Frederick John Smith in our issue of the 8th inst.; the gentleman deceased is the Rev. Frederick Jeremiah Smith, the highly respected and much beloved father of the former.

City and Guilds of London Institute.—The Earl of Selborne, chairman of the council of the Institute, will distribute the scholarships and prizes gained by the students of the Institute during the past year, on Thursday, December 4th, at the Fishmongers' Hall. The Lord Mayor will preside.

Tenders for Electric Lighting Wanted.—The Grosvenor Gallery Management is advertising for tenders for (1) engines and boilers, (2) supplying and laying cables, wires, and accessories, (3) electric light fittings. Plans and drawings, with general conditions of contracts, copies of specification, forms of tender, and all further information can be had at the offices of the engineers, Messrs. Mackenzie and Brougham, 15, Great George Street, Westminster, S.W., on and after 20th inst. Tenders to be delivered on the 29th inst.

Electricity and Health.—The opening address of the 131st session of the Society of Arts was delivered on Wednesday night by Sir Frederick Abel, chairman of the council, before a large audience. The lengthy and interesting paper commenced with a tribute to the memory of Sir William Siemens, who, said Professor Abel, "had he been present would have rejoiced to bear testimony to the continued steady progress made during the past year in the application of the electric light." The recent Health Exhibition, the chairman continued, was an instance of this, for during the whole of that exhibition over 5,000 glow lamps and 334 arc lights, yielding a candle-power light of 375,000, were worked with a total expenditure of only 1,180 tons of coal; whilst other electric light installations, upon a much less extensive scale than at South Kensington, but still of considerable magnitude, had come into operation during the year. The application of the light in small quantities to private houses had been the subject of many experiments by well-known electricians, and considering that the glow lamp was only in the fifth year of its existence, there was every reason to be very hopeful of its future development in the direction of permanence and of the consequent cheapening of domestic applications of the electric light. After a glance at the development of electricity for military purposes, Professor Abel referred to the attempt to utilise the agent as a motor, alluding *en passant*, to the Siemens electric railway at the Paris Exhibition, the line between the Vienna Exhibition and the Praterstern, the Portrush and Giant's Causeway Railway, the Brighton Electric Railway, and several experimental lines in America. The result of recent trials seemed to foreshadow a future for the employment of electricity as the motive power, not merely for small pleasure craft but for small vessels in which silent progression is a desideratum sufficiently important to counterbalance the defect due to the limited period during which the motive power could be maintained; and as to the transmission of heavy weights by electricity, the public would shortly see a system in application at Millwall, devised by Prof. Jenkin, for moving goods trucks by telpher lines suspended as telegraph wires now are. A considerable portion of the address was devoted to a review of the effects likely to result to the public from the Health Exhibition—"effects," said Prof. Abel, "which cannot fail to prove fruitful of great benefit to the country." Sir Frederick admitted the mixed character of the collection, but, speaking generally, he expressed the opinion that it was replete with instruction and interest to the masses, and even to the most educated, whilst the conferences added much to that instructiveness. The sanitary and insanitary houses erected side by side in the grounds emphasised the increasing importance of the comparatively new profession of the sanitary engineer, and with regard to smoke abatement, a comparison of the collection at the Smoke Abatement Exhibition of two years ago and the Health Exhibition, showed that there was no single instance in which makers had not made an effort to achieve an advance, either in the extent to which the escape of smoke and the wasteful consumption of fuel were avoided and ventilation secured in the warming of a room, or in simplicity of construction or arrangement of an already efficient stove. The address concluded with an approving reference to the steps now being taken in the promotion of technical education.

Primers of Electricity.—Over 70,000 copies of Prof. E. J. Houston's primers of electricity, which number 25 in all, were sold during the Philadelphia Electrical Exhibition.

The Telephone in India.—A correspondent of an American contemporary at Calcutta has furnished the following statement of the total number of telephone subscribers in East India on October 1st:—Calcutta, 244; Bombay, 204; Madras, 36; Rangoon, 98; Colombo, 34; Kurrachee, 25.

The Edison Electric Light Company of America.—Mr. Edison has for some time been dissatisfied with the direction and management of the company with which he is connected, and a change in the constitution of the board has taken place. It is understood that active steps will now be taken to push the enterprise and make some returns to the stockholders, no dividends having been paid since the company was formed.

NEW COMPANY REGISTERED.

Chelsea Electricity Supply Company, Limited.—Capital £100,500, divided into 20,000 shares of £5 each, and 500 founders' shares of £1 each. Registered office, 5, Lime Street Square, E.C. Objects:—To supply electricity for public or private purposes. Signatories (with one share each)—T. V. Lister, 38, Cadogan Square (Assistant Under Secretary of State, Foreign Office); F. L. Rawson (electrical engineer), 11, Queen Victoria Street; Colonel Sir Francis Bolton, C.E., 19, Grosvenor Gardens; A. E. Tylor, 22, Michael's Grove, South Kensington; J. C. St. Quintin, Blackheath; O. Woodhouse (civil and electrical engineer), 20, Upper Phillimore Gardens; H. J. Davies, 48, Gayton Road, Hampstead. The signatories are to appoint the first directors; qualification, 10 shares. Registered 18th inst. by Sydney Morse, 5, Lime Street Square, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Edison and Swan United Electric Light Company, Limited.—The first return of this company, made up to 11th inst., was filed on the 15th inst. The nominal capital is £1,000,000 in £5 shares. The shares issued are 17,141 fully paid, and 89,261 partly paid; upon the latter £3 per share has been called up. The calls paid amount to £353,363, leaving £125 unpaid. Registered office, 57, Holborn Viaduct.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

(*Continued from page* 396.)

AFTER the reading of Dr. Hopkinson's paper, as reported in our last issue,

Prof. W. G. ADAMS, President, read "An Account of Experiments with Alternate-Current Machines." In July, 1884, some tests were made by the author at the South Foreland Lighthouse, with three De Meriten's dynamo machines. Two of the latter were provided with mechanical couplings. The machines had 5 rings of 12 magnets, or 60 in all, and the brushes were so arranged that $\frac{1}{5}$th, $\frac{2}{5}$ths, $\frac{3}{5}$ths, or the whole, of the rings could be used. Two machines mechanically coupled together, but each driven by separate bands, being set running at 600 revolutions per minute, the clutches were opened, but the machines continued to run steadily, giving a total current of 221 ampères. One of the two machines was then run as a motor, and it was found to work in unison with the driver; this was the case whether the motor was loaded or not. The experiment was then tried of running three machines by three belts and then slipping off two of the latter; in this case the two machines ran steadily as motors. Again, two machines were successfully used to drive a third machine and also a lamp, the arc of the latter being very steady. The general result arrived at was that it was better not to use the mechanical coupling.

In the discussion which followed the reading of the papers,

Mr. ALEXANDER SIEMENS stated that as the result of Dr. Hopkinson's investigations he had tried some experiments with alternate current machines and he had obtained substantially the same effects as those pointed out. The following table shows some of the results obtained in motor experiments:—

Siemens Bros. & Co., Generator W^1, No. 1337[a]. Res. of Helix, 5 ohms, 500 revs. per minute.

Motor W^3, No. 829[a]. Res. of Helix, 1·9 ohms, 1,000 revs. per minute.

Mechanical H.P. absorbed by generator.	Res. of leads in ohms.	Current in ampères.	Mechanical H.P. reclaimed on brake of motor.
10·45	0·0	12·77	5·33
,,	3·8	,,	,,
* ,,	8·0	,,	,,
8·35	48·8	7·2	1·90
,,	52·5	,,	,,
,,	55·2	7·1	,,
,,	58·9	6·8	,,
* ,,	65·0	,,	,,
* 7·31	71·1	5·8	·76
4·5	3·8	9·6	,,

Inasmuch as a direct current motor would turn in the same direction, whether actuated by a positive or a negative current, he thought that probably alternating currents would work it. An experiment made on this supposition proved successful, but only when the bars of the machine were arranged in accordance with Professor Hughes' investigations. A somewhat curious fact came out, viz., that the brushes could be turned considerably out of their normal position without the machine (a series one) being affected.

Prof. AYRTON pointed out that Dr. Hopkinson had commenced by a theoretical proof, and then showed by practice that his theory was correct, an order of proceeding which was very unusual. He explained the difficulties of making accurate measurements of alternate currents; the employment of a resistance in the circuit with the object of measuring the potentials at the ends was unfortunately an extremely insensitive one. With reference to the use of a condenser, as suggested by Dr. Hopkinson, for increasing the potential of the machine, he would state that Mr. J. Munro had patented the idea some years ago, but had abandoned it in consequence of the great difficulty of constructing condensers sufficiently well to avoid being pierced. He would draw attention to the fact that the experiments with a Ruhmkorff coil proved that it was possible to obtain a shock from an alternate current machine, no matter how perfectly it was insulated.

Mr. H. E. HARRISON said that the results of Mr. Alexander Siemens, as given by his table, showed how very erronerous was the ordinary method of calculating the power, &c., of alternate current machines.

Dr. E. HOPKINSON referred briefly to some results in the paper.

Prof. SYLVANUS THOMPSON pointed out that if a galvanometer which had a large number of convolutions of wire was employed for measuring alternate currents, the self-induction in the coils would produce considerable error in the measurements; the rate of the alternations also would modify the results obtained. As regards the experiment of Mr. Alexander Siemens with a direct current machine, viz., the turning of the brushes, he would state that he had obtained a similar effect, but the machine used was of very bad construction. The use of a condenser had been made by Jablochkoff as early as 1878. Its employment, he would point out, did not produce any additional power. He had made some experiments with an induction coil, in which one terminal was connected to earth and the other to a plate of tin foil, a number of other plates being placed parallel in a row at a few inches apart from each other; he found that sparks could be drawn from any one of the plates, although the number of the latter was very considerable.

The meeting then adjourned.

CITY NOTES.

Spanish National Telegraph Company, Limited.—The numbers are published of 160 6 per cent. mortgage debentures, amounting to £16,000, drawn on the 10th inst., for repayment at par on December 31st, at the National Bank of Scotland, Limited, 37, Nicholas Lane, E.C.

United Telephone Company, Limited.—The Directors have resolved that an interim dividend at the rate of 5 per cent. per annum, be paid for the half-year ending 31st ultimo. Dividend warrants will be posted to the shareholders on the 2nd proximo.

Change of Office. — Mr. Charles R. Heap, Sole European Agent of the Electro-Dynamic Company, of Philadelphia (Griscom's patents), has removed from Archway House, Bush Lane, Cannon Street, E.C., to No. 62, Coleman Street, E.C.

The registered office of the Electric Apparatus Company is now situate at 60, Queen Victoria Street, E.C.

London Platino-Brazilian Telegraph Company.—An interim dividend of 1s. 3d. per share is payable, free of income-tax.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 14th, were £3,393; after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th November, are £2,123, as compared with £2,331 in the corresponding period of 1883.

* Res. at which motor stopped.

NEW PATENTS—1884.

14897. "Combined ventilator and electro-motor." E. S. SHELDON. Dated November 12.

14916. "Dynamo-electric machines." S. PITT. (Communicated by C. de Nottbeck.) Dated November 12.

14927. "Electric switch." A. KHOTINSKY. Dated November 12. (*Complete.*)

14933. "Construction of box, trough, or cell for galvanic batteries." T. J. JONES. Dated November 12. (*Complete.*)

14953. "Electrical apparatus for communication between passengers and guards and drivers of railway trains." J. RADCLIFFE. Dated November 13.

14981. "Construction and application of carbon or carbonaceous electrodes, called hose electrodes, for primary and secondary elements." R. H. RADFORD. (Communicated by H. F. B. Schaefer.) Dated November 13.

15025. "Contact makers for the holders of incandescent electric lamps." A. SWAN. Dated November 14.

15030. "Electric arc lamps." F. THORNTON, O. ROMANZE. Dated November 14.

15056. "Cells for galvanic batteries." J. B. SPENCE, H. A. FERGUSSON. Dated November 15.

15069. "Electric meter." A. P. TROTTER. Dated November 15. (*Complete.*)

15080. "Telegraphic apparatus for the reproduction of writings and drawings." S. and S. R. CHATWOOD. Dated November 15.

15106. "Purifying, separating, or decomposing liquids by electrolysis." A. Z., N. G. A. and L. P. G. CHAMPY. Dated November 17.

15111. "Governors for regulating speed of motors driven by electricity." F. JENKIN. Dated November 17.

15143. "Boxes or cells for primary and secondary batteries." C. MOSELEY. Dated November 18,

15155. "Electro-magnetic engine." S. W. MARQUAY. Dated November 18.

15164. "Burglars alarms or apparatus for signalling the entry or passing of persons over given spots." J. O. SPONG. Dated November 18.

15167. "Arc electric lamps." C. F. COOKE, W. ROBINSON. Dated November 18.

15168. "Arc electric lamps." C. F. COOKE, W. ROBINSON. Dated November 18.

15174. "Separating or supporting, or operating electrodes or elements in or for batteries or accumulators, or for developing or utilising electric force." J. S. WILLIAMS. Dated November 18.

15175. "Separating or supporting, or operating electrodes or elements in or for batteries or accumulators, or for developing or utilising electric force." J. S. WILLIAMS. Dated November 18.

15176. "Separating or supporting, or operating electrodes or elements in or for use in batteries or accumulators, or for developing or utilising electric force as well as for other purposes." J. S. WILLIAMS. Dated November 18.

15186. "Electric incandescent lamps." S. PITT. (Communicated by C. F. Beck and J. Van Gestel.) Dated November 18.

15189. "Arc electric lamps." C. F. COOKE, W. ROBINSON. Dated November 18.

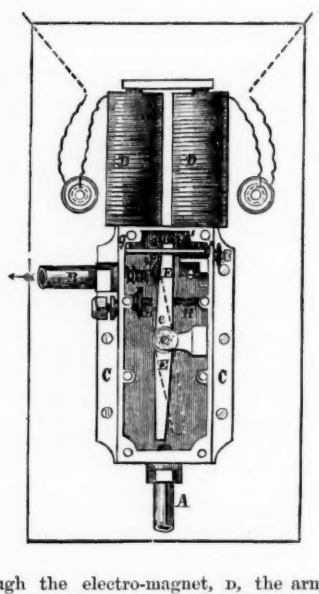
15190. "Arc electric lamps." C. F. COOKE, W. ROBINSON. Dated November 18.

15191. "Shunts for arc electric lamps." C. F. COOKE, W. ROBINSON. Dated November 18.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

4969. "Improvements in means for regulating the supply of gas in railway trains by electricity." W. E. LANGDON. Dated March 15. 6d. The object of this invention is to economise the consumption of gas in railway trains so that the full supply is only permitted at the discretion of the guard or other attendant at such times as may be requisite and not to be kept burning, as now is the case, throughout the journey. The invention consists of a means for operating from the guard's van or other part of the train by the aid of electricity, commutators, stop cocks or valves, so that the supply of gas may be turned fully on or nearly off at pleasure throughout the train. At the point from which the said stop cocks are required to be operated, the inventor places a suitable switch or key for the purpose of controlling the battery current, and he connects this key to the battery and to the electro-magnets or coils in the ordinary manner by one or more wires in such a manner that a current, positive or negative, may be sent through the coils as may be desired. The fig. is a front

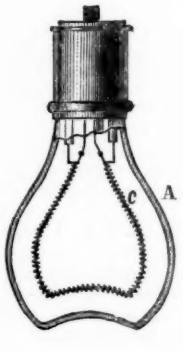
view of the interior of the apparatus for controlling the supply of the gas; A is the gas supply pipe or tube from the cylinder or reservoir in which the gas is stored; B is the pipe or tube leading to the burners of the several lamps on one carriage; C is a case or box formed of a non-magnetic metal, or having that portion in contact with the electro-magnets so formed, or it may be formed entirely of wood, ebonite or other non-magnetic material capable of withstanding the pressure of the gas which has to pass through it; D is an electro-magnet having its iron or steel cores or poles, d, d^1, carried through at the upper end of the box, C, so as to completely fill the openings made for their reception and so leave no space for the escape of the gas; E is a bar of magnetised steel pivotted at e, within the case, C, carrying upon its upper portion a pad or stop valve, f, which stop valve, when the magnet, E, is in the dotted position, is so arranged as to close or nearly close the mouth or end of the tube, B, or otherwise limit the supply of gas passing into the tube, B, from the box, C. H, H^1 are stops for limiting the movement of the bar, E, the stop, H^1, being a permanently fixed screw or pin, and the stop, H, being a screw capable of adjustment at will; G is an armature locking bar employed only when the cores, d, d^1, are formed of soft iron pivotted at g, g^1, being composed of an ordinary armature of soft iron having fixed upon it a brass bar, G^1, which, when the armature is uninfluenced by a current of electricity being passed through the electro-magnet, engages with the magnet, E, in such a manner as to keep it in one of two positions, viz., either as shown in full lines (open) or as shown in dotted lines (closed or nearly so). When a current, either positive or negative, is



passing through the electro-magnet, D, the armature, G, will be drawn up towards the cores, d, d^1, and carrying with it the locking bar, G^1, attached thereto, and will leave the magnet, E, free to move to one side or the other according to the direction of the current. The tubes, A, B, at the points where they enter the case, C, as also the adjusting screw, H, are so fixed as to prevent any escape of the gas within the case, C, the lid of which is packed with an India-rubber or other suitable washer, and firmly screwed down by nuts and screws. The case is thus rendered air or gas tight, the only means of ingress and egress being those afforded by the tubes, A, B. This instrument the inventor fixes upon that end or portion of the railway carriage or van most convenient to obtain connection with the tubes conveying the gas to the lamps of the carriage or van. In the guard's van is placed an electrical battery, the two poles of which are connected to a reversing key or switch, which reversing switch is connected by one or, by preference, by two wires, with each coach or vehicle fitted with the electrical valve. Let it be assumed that the valves of the instruments in each carriage stand, as shown in full lines, viz., full open. All the valves being in this position, the gas will flow from A through the apparatus K, and out at B to feed the several lamps of each carriage. It is now desired to turn the gas down so that instead of its affording a full flame and a full light, it may only afford a minimum flame sufficient to retain ignition of the gas and so admit of the light being again raised to its full strength whenever desired. To do this the guard reverses his switch so as to send, say a negative current throughout the several valve instruments upon the train. This current being opposite to that employed to place the magnet, E, in the "open" position, passes through the electro-magnet, D, lifts the locking bar or armature, G, free from E, and produces that polarity in its cores, d, d^1, which causes the pole or core, d^1, to repel, and the pole, d, to attract the upper portion of the magnet bar, E. On the cessation of the current, which flows only so long as the guard is manipulating his reversing switch or commutator, the locking bar or armature, G, falls away from the cores, d, d^1, and locks the magnet bar, E, in the closed (dotted) position. The gas is now cut off to the extent to which it has been regulated by the regulating screw or stop, H, and will remain so until an opposite current is sent from the guard's van. This will be effected by the guard operating his switch in the ox direction. An opposite, say a positive current is by this action sent through each instrument, the armature, G, is again lifted, the magnet bar, E, is set free, and its upper portion is now repelled by the pole, d, and attracted by the pole, d^1. On the cessation of the current, the armature, G, falls and locks the magnet, E, in the "open" position.

9050. "Improved mechanical telephone." W. P. THOMPSON. (Communicated from abroad by A. A. Knudson, of America,) Dated June 17. 6d. The object of this invention is to produce a mechanical or acoustic telephone, so called, which shall more perfectly reproduce the sounds of speech at a distance within the limit of mechanical transmission of sound waves. The telephone is made preferably about eight inches in diameter, constructed in two parts with an internal recess. The two sections of the case are fastened together by screws at top and bottom, which also secure the edges of the composite diaphragm, thus allowing sufficient space on each side of said diaphragm to admit of its vibrating properly. A circular opening through the front of this case or shell allows the voice of the speaker to impinge directly upon the face of a metallic disc which rests against the composite diaphragm. A similar opening through the base of the case allows space for the placing of the sound collector. The diaphragm is composed of very thin strips of wood, which for convenience or utility may be interwoven, as in what is commonly known as basket work, and of which two layers may be used, firmly pressed together with a filling of wood, paper, cloth, or other fibrous substance between them. A circular metallic disc rests upon the diaphragm opposite the centre of the opening. A hole through the centre of this disc admits of the passage of the conducting line wire, the end of which is securely wound around a pin, of sufficient length to allow its ends to rest on the surface of the disc, and thus prevent the wire from slipping out, while at the same time the tension of the line wire presses the disc firmly against the diaphragm. Behind the diaphragm is placed a sound collector, which may be constructed of wood or other resonant material. A hole through the centre of this sound collector admits of the passage through it of the line wire upon which it moves freely. The base of the sound collector is slightly concaved, so that its edges alone touch the diaphragm, against which it is pressed by means of a spiral spring at its base, one end of which is secured to the line wire while the other acts against the base of the sound collector, the line wire passing freely through the centre of the spiral.

9649. "Improvements in and relating to incandescence electric lamps." H. H. LAKE. (Communicated from abroad by N. S. White, of America.) Dated July 1. 6d. Relates to incandescence electric lamps, and especially to a burner comprising a carbon and earths, metals, minerals, or other material used in connection with the carbon, whereby certain advantages are obtained; to the manner of uniting the carbon with the platinum or other conducting wires; to the shape and form of the glass globe or bulb forming the shell of the vacuum chamber; to the use in connection with the said lamp of a reflector, and to a wire gauze protector. It is preferred to make the carbon filament of silk, flax, cotton or linen fibre or thread. To illustrate one method of treating the fibre to produce the composite burner, the inventor describes the process which he prefers to employ when silver is used as the light-diffusing material. He first makes an ammoniacal solution of silver, and into this solution the fibre is placed, and allowed to soak therein for from two to ten or



twelve hours, when it is largely covered or saturated with ammoniacal oxide of silver. The fibre thus treated is stretched or dried, then coated with an adhesive solution, and then covered with fine plumbago or gas-house retort carbon, or a mixture of both, the adhesive solution holding it to the fibre. It is then cut into suitable lengths and is placed in grooves formed in a carbon plate and covered with a thin layer of plumbago, gas-house retort carbon, or a mixture of both, and is then carbonised in a muffle. After carbonisation the carbon filaments are placed in the silver solution and allowed to remain therein from three to eight hours. This fills the interstices and covers the surface of the carbon with silver, so that, it may be said, the carbon is charged on its surface

with silver. Each carbon is then placed in a vacuum and a current of electricity passed through it. It is then taken out, and in some instances heated again, when it is ready for use. When other metals or substances are used in lieu of the silver, the fibre and carbon are treated by substantially the process herein described, that is to say, if a metal is used, it is preferably reduced to a solution and precipitated upon the carbon, but it may be attached thereto by an adhesive composition, or in any other desirable manner; and the same may be said of such other substances as may be employed. The fig. represents another form of the invention in which the light-diffusing material instead of being attached directly to the carbon filament is not supported thereby, but is placed in close relation thereto. Any suitable carbon filament may be used in this modification, and it is preferred to use one that is made of silk, flax, cotton, linen, or other similar fibre, coated by means of an adhesive solution of fine plumbago, gas-house retort carbon, magnesia, silex or ground glass, or either, or any combination of these materials, and placed in grooves in a carbon plate and covered with plumbago, gas-house retort carbon, magnesia, silex or ground glass, or either or any combination of these materials, and then carbonised in a muffle. Each carbon before use should be placed in a vacuum and a current of electricity passed through it. The carbon is then arranged within the vacuum chamber of the glass bulb or globe, in close proximity and auxiliary to the burner or light. And the auxiliary burner or light may be made of any suitable light-diffusing material, and may be arranged in any form in relation to the carbon. It may be made in the form of a light sleeve enclosing the carbon, or as a spiral wire, as shown in the fig.

11876. "Improvements in boxes or cells for primary or secondary batteries." F. G. HOWARD. Dated September 2. 6d. Consists of a particular method of grooving and dovetailing together the pieces of wood forming the cells.

CORRESPONDENCE.

The Telephone Patents.

Your correspondent "S.'s" thirst (I was about to write *insatiable* thirst) for information about telephones really merits some regard from those who possess, or think they possess, any information in regard thereto, and as I have on several occasions sent to the REVIEW lists of patents for telephone instruments, wherein I have specified those patents for receivers which have a metallic diaphragm, or its equivalent, and for transmitters which have the combination of a diaphragm with a tension regulator, I will now refer him to the REVIEW of August 19th and 26th, of 1882, and of April 21st, 1883, where he will find those lists up to the 21st August, 1882, and to the REVIEW of September 8th, 1883, and of December 1st, 1883, and to the REVIEWS *passim* from January 1st, 1882, to present date, where he will find all the information he seeks for; and if he has not the REVIEW for those years, I advise him to procure them without delay. In regard to the patents since August, 1882, to January, 1884, I shall shortly send to the REVIEW a list characterising them, as I have done for the previous patents.

I will now proceed to say something touching the remarks of "S." in the REVIEW of 15th inst., and former dates.

"S." wrote: "As a tension regulator must necessarily be employed, and as it is equally requisite that there should be some surface on which the sound-waves may be received, the whole question turns on the legal interpretation of the terms tympanum and diaphragm." "S." is referred to the case of the U.T. Co. *v.* Cox-Walker, for the legal interpretation by Mr. Justice Fry, who broadly defined the meaning of those words to be "something which separated something from something else," and in the case before him he broadly (very broadly) defined a diaphragm or tympan to be any substance above or below the tension regulator. This, then, is the *legal* interpretation of those words; but, I opine, it differs materially from the scientific and commonly-accepted meaning.

I may as well fire at two birds with one stone (I will not say kill two birds with one stone), and I take leave to dissent from the opinion expressed by "F. T. H." in the REVIEW of November 1st, "that the Hughes microphone requires no diaphragm." My knowledge of the Hughes beautiful discovery, the microphone, as made by him, is that it always was attached to a diaphragm. His three iron nails microphone, and his carbon pencil microphones, all were attached to a sounding-board or diaphragm, according to the legal interpretation of Mr. Justice Fry, and I agree with "S." that it is not "so very easy to make a workable instrument to clear Edison's patent."

Hughes's original microphone is an excellent transmitter; but, unfortunately, it is the combination of a diaphragm or tympan with a tension regulator, and clearly comes within the claim of the Edison patent, according to the judgment rendered by Mr. Justice Fry. The Gower-Bell and the Johnson transmitters are purely and simply Hughes's microphone in multiple. "F. T. H." writes: "We may therefore use a carbon tension regulator, and we may use a resonant case." It no doubt is true that either of them may be used separately, but not combined, so long as the judgment of Mr. Justice Fry remains in force, and this is the reason why the Hughes microphone is not used by any one. A permanent magnet is the equivalent of an electro-magnet; both are for the time being iron magnetised, that is magnets; and it matters not by what means the iron is magnetised.

I refer "S." to the REVIEW of December 1st, 1883, for information about Eldred's patent 676, of 1883.

As to the evidence in the case of the U.T. Co. *v.* Maclean, referred to by "S." about the *closed* circuit, that a break in the continuity destroys articulation, no doubt several eminent men expressed that opinion; but facts are stronger than opinions, and facts have demonstrated that breaks in the continuity do not destroy articulate speech. I have seen and tested several transmitters which have a tension regulator, but not the semblance of a diaphragm or tympan, and I have carried on conversations by means of them and of receivers, which have not a plate of iron or steel or other material capable of inductive action, fixed all round its circumference, and I have found their articulation free from the buzzing sound in the Bell receiver, and more clear in tone.

I opine that "F. T. H." is in error when he states that "Bell (Morgan Brown) disclaims a tympan (a membrane) not capable (of itself) of inductive action," and also he errs (in my humble opinion) when he says: "it is a plain, palpable fact that a tympan, or tongue of non-inductive material carrying a disc or button of material which is inductive, or attached by a pin to a bar or tongue armature, and attracted by electro-magnetism, is outside the Bell patent."

I grant that the use of a tongue, as stated, is outside Bell's patent, but under the decision of Mr. Justice Fry, and of the Court of Appeal, an iron disc held down all round its circumference is covered by Bell's patent, and so must be any equivalent of such a disc. And is not a tympan made of any material having a disc or button of material which is inductive, an equivalent for the iron disc? Bell disclaimed the use of "a membrane like goldbeater-skin"; that is the disclaimer of a particular substance, and surely such a disclaimer cannot cover all the equivalents of an iron tympan.

In my opinion the Bell patent, until it be declared void because of prior publication of material parts of it, which may come sooner than the owner of it thinks, has the exclusive right to the use of an electro-magnet in combination with a plate of iron or steel, or other material capable of inductive action (or the equivalents of such a plate, having a piece of iron secured to its centre over the end of the magnets) fixed down all round its circumference, as per 6th claim in disclaimer. The 7th claim is for the combination with just such a plate of a magnet having coils upon the end or ends nearest the plate. The 8th claim is for the combination of just such a plate, with a permanent magnet having a soft iron pole-piece for the core of the coil.

It is, then, clear that all of these kinds of magnets can

be used in either place, provided they be not combined with a plate, as described, held down all round its edge.

Common Sense.

November 18*th*, 1884.

The Bell and Edison Patents.

Your correspondent "S." seems to be still "hugging" the terms diaphragm and tympan. The judicial interpretation of those terms does not affect in the slightest degree the statements contained in my previous letter. A *diaphragm* is a separator or partition—something which separates something from something else—that is, anything which separates the air above from the material below, or *vice versâ*. A *tympan* means anything fixed or stretched in the nature of a drumhead. A tympan when in action is "set into ripples, and those ripples have nodal lines in circles all round," and the resultant is a movement up and down at the central point: such is *tympanic action*. But what have we to do with this if we do not use either a tympan or diaphragm?

"S." asked for information as to what might be used, and when told, suggests that his informant's information is useless or unreliable, or of an imaginary character. I told "S." what might be used—what Edison's patent says may be used—a resonant case. Edison has specifically disclaimed the resonant case part of his apparatus, and having done so, he not only disclaims his own resonant case, but all others. That being so, a workman may always use his tools to the best advantage, and, therefore, as I said before, he may make the resonant case as resonant as he pleases. What more does "S." want? Does he want me to show him exactly how to make it, and then give him a certificate that it is free of Edison's patent? That such an instrument will work well, and make a good practical transmitter, I know from experiment and use; and that it is not an infringement anyone may see by the application of a little common sense.

As to the remarks of "S." about the Scotch trial, and the weight of evidence as to a *closed* circuit, I can only say that upon many points the evidence at *that* trial was in favour of the Edison patent, and it was upheld upon *all* points. But how did the Edison patent pass through the ordeal of the trial in London, before Mr. Justice Fry? I do not think that the action of the microphone is at all inconsistent with minute makes and breaks when in operation. But however that may be, the onus of proof rests with those who hold that it is in a *closed* circuit.

With regard to a permanent magnet being the obvious equivalent of an electro-magnet, "*in the main circuit or line wire.*" Where does "S." propose to put his receiver if not "*in the main circuit or line wire*"? The novelty in the application of the permanent magnet was that for *transmitting* and receiving it required no battery. It was as a transmitter that the application was novel. For that purpose there were properties in it not possessed by an electro-magnet *without a battery*; but in a *receiver as a receiver only* the mere substitution of a permanent magnet for an electro-magnet required no experiment, involved no ingenuity, and was no invention; moreover, Bell does not claim it except in combination with the plate tympan, that is, whatever is free to an electro-magnet is free to a permanent magnet. As I understand it, a patent could not be taken out for the mere substitution of a permanent magnet for an electro-magnet, not only for telephonic, but for any other purpose. And, therefore, I hold that a permanent magnet is the obvious electrical equivalent of an electro-magnet. Of course, I cannot expect "S." to "admit" it, but possibly it may be able to stand good without his support.

May I be permitted to ask you, Sir, or any of your readers, where I could get a copy of the report signed by Sir William Thomson as one of the judges of the Philadelphia Exhibition of 1876? May I also ask if any of your readers can tell me of any American paper received in this country prior to December 9th, 1876, giving an account of Bell's apparatus at the above named Exhibition?

F. T. H.

Derby, *November* 17*th*, 1884.

Galvanometer Constants.

Permit me to draw your attention towards a subject which is treated rather in a superficial way by all the existing text-books on electrical testing.

In taking the "constant" of a Thomson's reflecting galvanometer for insulation or capacity measurements, the use of a resistance box forming a variable shunt, instead of the usual shunts of $\frac{1}{9}$th, $\frac{1}{99}$th, and $\frac{1}{999}$th, is recommended by many writers. (*Vide* Kempe, 3 edit., p. 330, Munro and Jamieson's Pocket-book, p. 149, &c.) Now in this case the exact resistance of the galvanometer must be known for calculating the multiplying power of the shunt; yet the determination of this resistance is by no means easy. To insert the Thomson in the fourth side of a Wheatstone bridge would hardly do, unless a *second very sensitive* instrument be available, on account of the danger that the magnetism of the first galvanometer might be destroyed by sending a current of even moderate strength through the bridge.

The resistance of the instrument at the standard temperature is usually marked on the coils, but I doubt whether the insertion of a thermometer in the protecting case, as is sometimes done, would prove to be of any value for determining the actual resistance.

Mr. Philipps's suggestion to measure the resistance of the $\frac{1}{9}$th shunt would be very good if the interior of the shunt box was at the exact temperature of the galvanometer coils. But any slight error, say of $\frac{1}{10}$th unit, produces a tenfold error in the final result.

If it were possible to set the needle of the Thomson, whose resistance is to be measured, at right angles to the coils, and fix it in this position, then the ordinary bridge method might be employed with any simple form of galvanoscope, as in this case the effect of the coils of the Thomson on its needle would be nil. Unfortunately this cannot be done with the common form of the apparatus, on account of the damping vane; even with the instruments with hinged coils it is by no means easy.

Somebody might suggest to join the terminals on the base in a way that the currents in the four coils oppose each other, but in a common (*i.e.* not differentially wound) instrument the number of turns is usually not exactly the same in the four coils.

I need hardly add that Sir W. Thomson's well known plan to determine the resistance when a second galvanometer is not at hand will not do for an exact determination.

Hoping that you, or one of the numerous cable electricians among your subscribers, will be kind enough to advise me how to proceed, I remain,

A Foreign Member, S. T. E.

Alternating Current Machines.

I notice in the current number of the REVIEW, a report of Dr. Hopkinson's paper read before the Society of Telegraph Engineers on the electro-mechanical property of the alternating current to synchronise the rotations of the armatures of a number of magneto-electro machines when their circuits are connected. May I be permitted to state that this remarkable property of the alternating current was discovered by me in 1868, and is fully described in the *Philosophical Magazine* for January, 1869.

As my paper was much in advance of the electrical knowledge of the time and may not have found many readers, I shall be glad if you will find a place for the enclosed copy of it in your valuable journal.

H. Wilde.

Rockside, Alderley Edge,
Cheshire, *November* 17*th*, 1884.

[We shall endeavour to reproduce the paper of Mr. Wilde in our next issue.—EDS. ELEC. REV.

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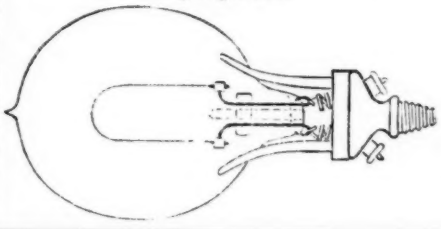

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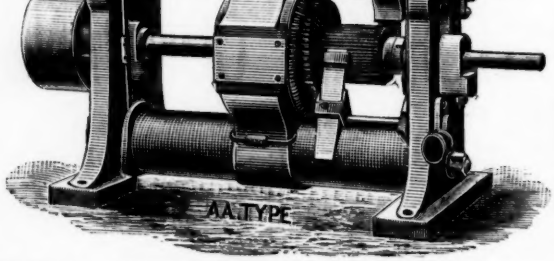

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